USAF SERIES

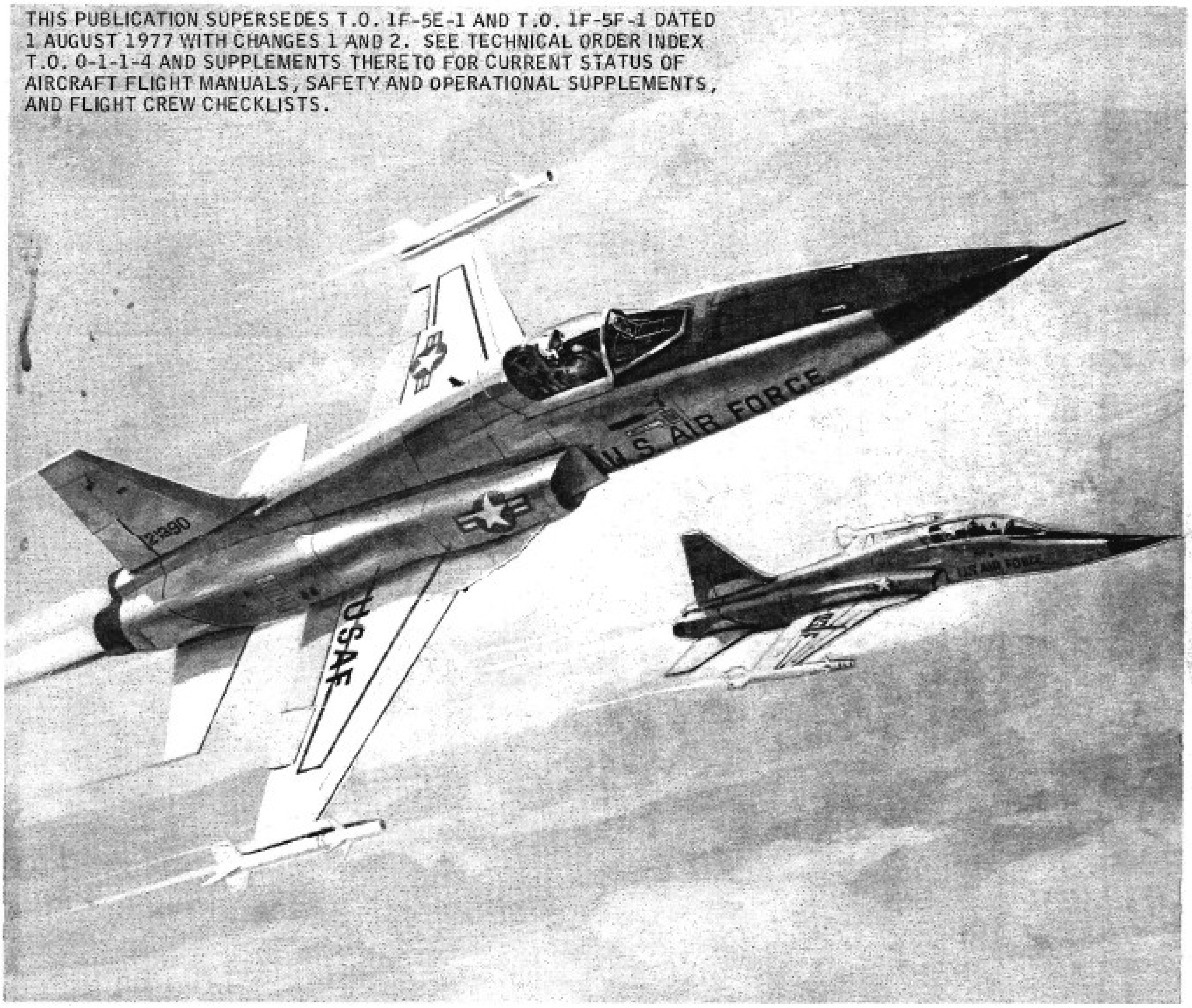
T.O. 1F-5E-1

F-5E/F FLIGHT MANUAL

AIRCRAFT

F33657-70-C-0717/F33657-76-C-0514
F33657-74-C-0041/F33657-76-C-0515

THIS PUBLICATION SUPERSEDES T.O. 1F-5E-1 AND T.O. 1F-5F-1 DATED 1 AUGUST 1977 WITH CHANGES 1 AND 2. SEE TECHNICAL ORDER INDEX T.O. 0-1-1-4 AND SUPPLEMENTS THERETO FOR CURRENT STATUS OF AIRCRAFT FLIGHT MANUALS, SAFETY AND OPERATIONAL SUPPLEMENTS, AND FLIGHT CREW CHECKLISTS.



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F-5 1-1(I)H

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1 AUGUST 1978

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CURRENT FLIGHT CREW CHECKLIST

T.O. 1F-5E-1CL-1

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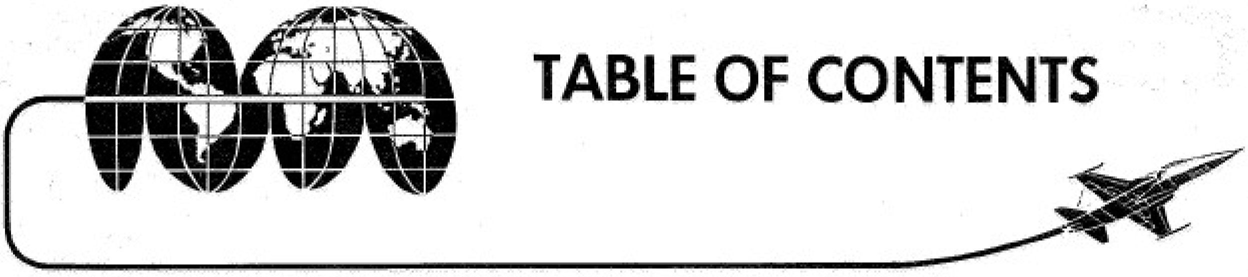

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SCOPE

This manual contains the necessary information for safe and efficient operation of your aircraft. These instructions provide you with a general knowledge of the aircraft and its characteristics and specific normal and emergency operating procedures. Your experience is recognized; therefore, basic flight principles are avoided. Instructions in this manual are prepared to be understandable by the least experienced crew that can be expected to operate the aircraft. This manual provides the best possible operating instructions under most conditions. Multiple emergencies, adverse weather, terrain, etc may require modification of the procedures.

PERMISSIBLE OPERATIONS

The flight manual takes a "positive approach" and normally states only what you can do. Unusual operations or configurations are prohibited unless specifically covered herein. Clearance must be obtained before any questionable operation, which is not specifically permitted in this manual, is attempted.

HOW TO BE ASSURED OF HAVING LATEST DATA

Refer to T.O. 0-1-1-4 for a listing of all current flight manuals, safety supplements, operational supplements, and checklists. Also, check the flight manual title page, the title block of each safety and operational supplement, and all status pages contained in the flight manual or attached to formal safety and operational supplements. Clear up all discrepancies before flight.

ARRANGEMENT

The manual is divided into seven fairly independent sections and an appendix to simplify reading it straight thru or using it as a reference manual.

SAFETY SUPPLEMENTS

Information involving safety will be promptly forwarded to you in a safety supplement. Urgent information is published in interim safety supplements and transmitted by teletype. Formal supplements are mailed. The supplement title block and status page (published with formal supplements only) should be checked to determine the supplement's effect on the manual and other outstanding supplements.

OPERATIONAL SUPPLEMENTS

Information involving changes to operating procedures will be forwarded to you by operational supplements. The procedure for handling operational supplements is the same as for safety supplements.

CHECKLIST

The flight manual contains itemized procedures with necessary amplifications. The checklist contains itemized procedures without the amplification. Primary line items in the flight manual and checklist are identical. If a formal safety or operational supplement affects your checklist, the affected checklist page will be attached to the supplement. Cut it out and insert it over the affected page but never discard the checklist page in case the supplement is rescinded and the page is needed.

HOW TO GET PERSONAL COPIES

Each pilot is entitled to a personal copy of the flight manual, safety supplements, operational supplements, and a checklist. The required quantities should be ordered before you need them to assure their prompt receipt. Check with your publication distribution officer — it is his job to fulfill your T.O. requests. Basically, you must order the required quantities on the appropriate Numerical Index and Requirement Table (NIRT). T.O. 00-5-1 and T.O. 00-5-2 give detailed information for properly ordering these publications. Make sure a system is established at your base to deliver the publications to the pilots immediately upon receipt.

FLIGHT MANUAL BINDERS

Looseleaf binders and sectionalized tabs are available for use with your manual. They are obtained thru local purchase procedures and are listed in the Federal Supply Schedule (FSC Group 75, Office Supplies, Part I). Check with your supply personnel for assistance in procuring these items.

WARNINGS, CAUTIONS, AND NOTES

The following definitions apply to "Warnings," "Cautions," and "Notes" found throughout the manual.

WARNING

Operating procedures, techniques, etc, which could result in personal injury or loss of life if not carefully followed.

CAUTION

Operating procedures, techniques, etc, which could result in damage to equipment if not carefully followed.

NOTE

An operating procedure, technique, etc, which is considered essential to emphasize.

USE OF WORDS SHALL, WILL, SHOULD, AND MAY

The words "shall" or "will" are to be used to indicate a mandatory requirement. The word "should" is to be used to indicate a nonmandatory desire or preferred method of accomplishment. The word "may" is used to indicate an acceptable or suggested means of accomplishment.

YOUR RESPONSIBILITY —TO LET US KNOW

Every effort is made to keep the flight manual current. Review conferences with operating personnel and a constant review of accident and flight test reports assure inclusion of the latest data in the manual. We cannot correct an error unless we know of its existence. In this regard, it is essential that you do your part. Comments, corrections, and questions regarding this manual or any phase of the flight manual program are welcomed. These should be forwarded on AF Form 847 thru your command headquarters to: San Antonio ALC/MMSRE, Kelly AFB, TX 78241.

PUBLICATION DATE

The date appearing on the title page of this flight manual represents the currency of material contained herein. The publication date is not the printing or distribution date. When referring to the manual, use the publication date plus the date of the latest change (when published).

AIRCRAFT DESIGNATION CODES

A code system to identify text, illustrations, charts and procedures peculiar to specific blocks or models of aircraft in this flight manual is as follows:

	APPLICABLE AIRCRAFT	CODE
a.	All F-5E and F-5F aircraft	No Code
b.	All F-5E aircraft only	Ⓔ
c.	All F-5F aircraft only	Ⓕ
d.	AF71-1417→AF71-1421 AF72-1386→AF72-1406 AF73-0846→AF73-0857 AF73-0859→AF73-0867 AF73-0869→AF73-0871 AF73-0873→AF73-0882 AF73-0884→AF73-0888 AF73-0890 & AF73-0892 AF73-0896→AF73-0899 AF73-0901 & AF73-0902 AF73-1626→AF73-1646 AF74-1471→AF74-1479 AF74-1482→AF74-1494 AF75-0457→AF75-0461 AF75-0501→AF75-0527	[E]
e.	AF77-0332→AF77-0335 AF77-0366→AF77-0379 AF77-1767→AF77-1770 AF78-0028→AF78-0037	[E-1]
f.	AF74-0958→AF74-0997 AF75-0314→AF75-0373 AF76-0471→AF76-0490 AF76-1616→AF76-1639 AF77-0328→AF77-0331	[E-2]
g.	AF74-1445→AF74-1458	[E-3]
h.	AF74-1459→AF74-1470 AF74-1495→AF74-1504 AF75-0491→AF75-0500 AF75-0618→AF75-0625	[E-4]
i.	AF74-1505→AF74-1575 AF75-0604→AF75-0617	[E-5]
j.	AF75-0573→AF75-0603 AF76-1643→AF76-1663	[E-6]
k.	AF76-1664→AF76-1676	[E-7]
l.	AF73-0889 AF73-0891	[F]
m.	AF77-0342→AF77-0350 AF77-0359→AF77-0361	[F-1]
n.	AF75-0735→AF75-0741	[F-2]
o.	AF76-1611→AF76-1613	[F-3]

When complete paragraphs or illustrations are applicable to specific blocks of aircraft, the appropriate code will appear opposite the heading. Notes, cautions, warnings, and steps of a procedure applicable to specific blocks of aircraft will have the code appear as the first item of the sentence or procedure. When an item is applicable to all but a few blocks of aircraft, the word EXCEPT will precede the code of the non-applicable block of aircraft; i.e. an illustration applicable to all aircraft except blocks [E-1] and [F-1] would be coded EXCEPT [E-1] [F-1]. An arrow → symbol between two serial numbers means "thru." An arrow symbol following one or more serial numbers means "and later aircraft."

TIME COMPLIANCE TECHNICAL ORDERS

The following TCTOs and ECPs are applicable to this Flight Manual. Reference to T.O. or ECP number within brackets [ ] in the text and illustration of the Flight manual requires referral to this list.. TCTOs not yet released, or those known to be completed, are not included. Referenced TCTOs will be deleted from this list after one year beyond the rescission date published on the TCTO or supplement extension, if issued. For a complete list of TCTOs affecting F-5E and F-5F aircraft, refer to Fighter Aircraft Numerical Index, T.O. 0-1-71, and supplements thereto.

T.O. NUMBER	TITLE	PRODUCTION EFFECTIVITY	RETROFIT EFFECTIVITY
1F-5F-505	Wing Flap Thumb Switch Modification	AF75-0691→AF75-0711 AF75-0735→AF75-0742 AF76-1592→AF76-1597 AF76-1614 & AF76-1615 AF76-1640→AF76-1642	AF73-0889 & AF73-0891 AF75-0681→AF75-0690
1F-5F-507	Redesign Of Sequenced Ejection System Selector Control Valve (ECP 296)	AF75-0736 AF75-0742 AF75-0755 AF76-1592→AF76-1597 AF76-1611→AF76-1615 AF76-1640→AF76-1642	AF73-0889 & AF73-0891 AF75-0709→AF75-0711 AF75-0735 AF75-0737→AF75-0741 AF75-0753 & AF75-0754
1F-5E-541	Speed Brake Travel Limitations (ECP 116)	AF73-0897→ AF73-0902 AF73-0952→AF73-0990 AF73-1630→ AF73-1646 AF74-0958→ AF74-0997 AF74-1362→ AF74-1575	AF71-1417→ AF71-1421 AF72-1386→ AF72-1406 AF73-0846→ AF73-0888 AF73-0890 AF73-0892→ AF73-0896 AF73-0933→ AF73-0951 AF73-1626→ AF73-1629 AF74-0957
1F-5E-573	Relocation of Dimming Control for LCOSS (ECP 158)	AF74-0986→ AF74-0997 AF74-1418→ AF74-1444 AF74-1532→ AF74-1575 AF74-1602→ AF74-1617	AF71-1417→ AF71-1421 AF72-1386→ AF72-1406 AF73-0846→ AF73-0888 AF73-0890 AF73-0892→ AF73-0902 AF73-0933→ AF73-0990 AF73-1626→ AF73-1646 AF74-0958→ AF74-0985 AF74-1362→ AF74-1417 AF74-1445→ AF74-1531 AF74-1582→ AF74-1601
1F-5E-576	Modification of Left Console AC/DC Circuit Breaker Panel	AF73-0866→ AF73-0888 AF73-0890 AF73-0892→ AF73-0902 AF73-0943→	AF71-1417→ AF71-1421 AF72-1386→ AF72-1406 AF73-0846→ AF73-0865 AF73-0933→ AF73-0942

T.O. NUMBER	TITLE	PRODUCTION EFFECTIVITY	RETROFIT EFFECTIVITY
1F-5E-585	Lower Gun Bay Access Door Modification	AF74-1439➤ AF74-1444 AF74-1512➤ AF74-1575 AF74-1606➤	AF71-1417➤ AF71-1421 AF72-1386➤ AF72-1406 AF73-0846➤ AF73-0888 AF73-0890 AF73-0892➤ AF73-0902 AF73-0933➤ AF73-0990 AF73-1626➤ AF73-1646 AF74-0958➤ AF74-0997 AF74-1362➤ AF74-1438 AF74-1445➤ AF74-1511 AF74-1582➤ AF74-1605
1F-5E-586	Standby Attitude Indicator—Addition of Constant Frequency Power Source (ECP 179)	AF75-0353➤ AF75-0373	AF71-1471➤ AF71-1421 AF72-1386➤ AF72-1406 AF73-0846➤ AF73-0888 AF73-0890 AF73-0892➤ AF73-0990 AF73-1626➤ AF73-1646 AF74-0958➤ AF74-0997 AF74-1362➤ AF74-1575 AF74-1582➤ AF74-1617 AF75-0314➤ AF75-0352 AF75-0442➤ AF75-0474 AF75-0491➤ AF75-0527
1F-5E-588	FCR Antenna Angle Change (ECP 168)	AF74-1561➤ AF74-1575 AF75-0330➤ AF75-0373 AF75-0493➤ AF75-0500 AF75-0515➤ AF75-0527	AF71-1417➤ AF71-1421 AF72-1386➤ AF72-1406 AF73-0846➤ AF73-0888 AF73-0890 AF73-0892➤ AF73-0902 AF73-0933➤ AF73-0990 AF73-1626➤ AF73-1646 AF74-0958➤ AF74-0997 AF74-1362➤ AF74-1560 AF74-1582➤ AF74-1617 AF75-0314➤ AF75-0329 AF75-0457➤ AF75-0461 AF75-0491➤ AF75-0492 AF75-0501➤ AF75-0514
1F-5E-592	Inadvertent Engine Shutdown	AF74-0958➤ AF74-0997 AF74-1369➤ AF74-1444 AF74-1447➤ AF74-1458 AF74-1460➤ AF74-1470 AF74-1477➤ AF74-1494 AF74-1495➤ AF74-1504 AF74-1505➤ AF74-1575 AF74-1582➤ AF74-1617 AF75-0500➤	AF71-1417➤ AF71-1421 AF72-1368➤ AF72-1406 AF73-0846➤ AF73-0888 AF73-0890 AF73-0892➤ AF73-0902 AF73-0933➤ AF73-0990 AF73-1626➤ AF73-1646 AF74-1362➤ AF74-1368 AF74-1445➤ AF74-1446 AF74-1459 AF74-1471➤ AF74-1476

T.O. NUMBER	TITLE	PRODUCTION EFFECTIVITY	RETROFIT EFFECTIVITY
1F-5E-594	Installation of Ballast (ECP 211)	AF74-1571➔ AF74-1575 AF75-0338➔ AF75-0373 AF75-0454➔ AF75-0456 AF75-0499 & AF75-0500	AF71-1417➔ AF71-1421 AF72-1386➔ AF72-1406 AF73-0846➔ AF73-0888 AF73-0890 AF73-0892➔ AF73-0990 AF73-1626➔ AF73-1646 AF74-0958➔ AF74-0997 AF74-1362➔ AF74-1570 AF74-1582➔ AF74-1617 AF75-0314➔ AF75-0337 AF75-0442➔ AF75-0453 AF75-0457➔ AF75-0461 AF75-0491➔ AF75-0498 AF75-0501➔ AF75-0527
1F-5E-599	Cabin Conditioning Circuitry (Power Source) Relocation (ECP-190)	AF74-0986➔ AF74-0987 AF74-1438➔ AF74-1444 AF74-1510➔ AF74-1575 AF74-1610➔ AF74-1617 AF75-0462➔	AF71-1417➔ AF71-1421 AF72-1386➔ AF72-1406 AF73-0846➔ AF73-0888 AF73-0890 AF73-0892➔ AF73-0902 AF73-0933➔ AF73-0990 AF73-1626➔ AF73-1646 AF74-0958➔ AF74-0985 AF74-1362➔ AF74-1437 AF74-1445➔ AF74-1509 AF74-1582➔ AF74-1609
1F-5E-600	Northrop Improved Seat Retrofit Program (ECP 256)		AF71-1417➔AF71-1421 AF72-1386➔AF72-1406 AF73-0846➔AF73-0884 AF73-0885 AF73-0896➔AF73-0897 AF73-0899 AF73-1635➔AF73-1640 AF74-1484 AF74-1505➔AF74-1519 AF74-1528➔AF74-1575 AF75-0612➔AF75-0617

T.O. NUMBER	TITLE	PRODUCTION EFFECTIVITY	RETROFIT EFFECTIVITY
1F-5E-611	USAF Update - Addition of 13 amp-hour Battery, VOR/ILS, and Marker Beacon (ECP 293)		AF71-1417→ AF71-1421 AF72-1386→ AF72-1393 AF72-1395 & AF72-1396 AF72-1398 AF72-1400→ AF72-1406 AF73-0846 & AF73-0847 AF73-0855 AF73-0865→ AF73-0866 AF73-0879 AF73-0881 & AF73-0882 AF73-0885 AF73-0896 & AF73-0897 AF73-0899 AF73-1635 & AF73-1636 AF73-1640 AF74-1484 AF74-1505→ AF74-1519 AF74-1528→ AF74-1554 AF74-1556→ AF74-1575 AF75-0612→ AF75-0617
1F-5-726	Navigation Lights Detent Modification (ECP 126)	AF73-0902 AF73-0972→ AF73-0990 AF73-1642→ AF73-1646 AF74-0963→	AF71-1417→ AF72-1421 AF72-1386→ AF72-1406 AF73-0846→ AF73-0888 AF73-0890 AF73-0892→ AF73-0901 AF73-0933→ AF73-0971 AF73-1626→ AF73-1641 AF74-0958→ AF74-0962
1F-5-729	Installation of Horizontal Situation Indicator (ECP 166)	AF74-0984→ AF74-0997 AF74-1397→ AF74-1444 AF74-1457 & AF74-1458 AF74-1504→ AF74-1575	AF71-1417→ AF71-1421 AF72-1386→ AF72-1406 AF73-0846→ AF73-0888 AF73-0890 AF73-0892→ AF73-0902 AF73-0933→ AF73-0990 AF73-1626→ AF73-1646 AF74-0958→ AF74-0983 AF74-1362→ AF74-1396 AF74-1445→ AF74-1456 AF74-1459→ AF74-1503
1F-5-736	Exterior Lighting System Changes (ECP 151)	AF74-1548→ AF74-1575 AF74-1617 AF75-0314→ AF75-0373	AF71-1417→ AF71-1421 AF72-1386→ AF72-1406 AF73-0846→ AF73-0888 AF73-0890 AF73-0892→ AF73-0902 AF73-0933→ AF73-0990 AF73-1626→ AF73-1646 AF74-0958→ AF74-0997 AF74-1362→ AF74-1547 AF74-1582→ AF74-1616

T.O. NUMBER	TITLE	PRODUCTION EFFECTIVITY	RETROFIT EFFECTIVITY
1F-5-740	Engine P_3 Dump System (ECP 192)	AF74-0987→ AF74-0997 AF74-1421→ AF74-1444 AF74-1502→ AF74-1575 AF74-1599→ AF74-1617 AF75-0314→ AF75-0373 AF75-0442→ AF75-0461 AF75-0491→ AF75-0501	AF71-1417→ AF71-1421 AF72-1386→ AF72-1406 AF73-0846→ AF73-0888 AF73-0890 AF73-0892→ AF73-0902 AF73-0933→ AF73-0990 AF73-1626→ AF73-1646 AF74-0958→ AF74-0986 AF74-1362→ AF74-1420 AF74-1445→ AF74-1501 AF74-1582→ AF74-1598
	F-5E/F GFAE (Communication and Navigation System) Changes (ECP 259)	AF75-0618→ AF75-0625 AF76-0471→ AF76-0490 AF76-1616→ AF76-1639 AF76-1664→ AF76-1676 AF77-0328→	AF74-0958→ AF74-0997 AF75-0314→ AF75-0373

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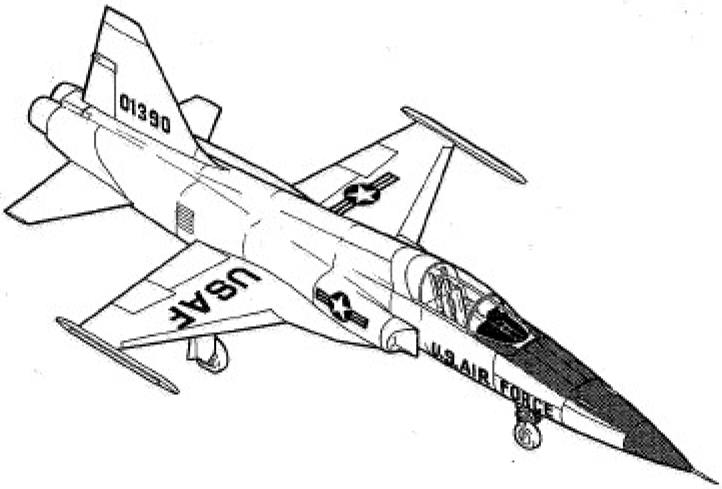
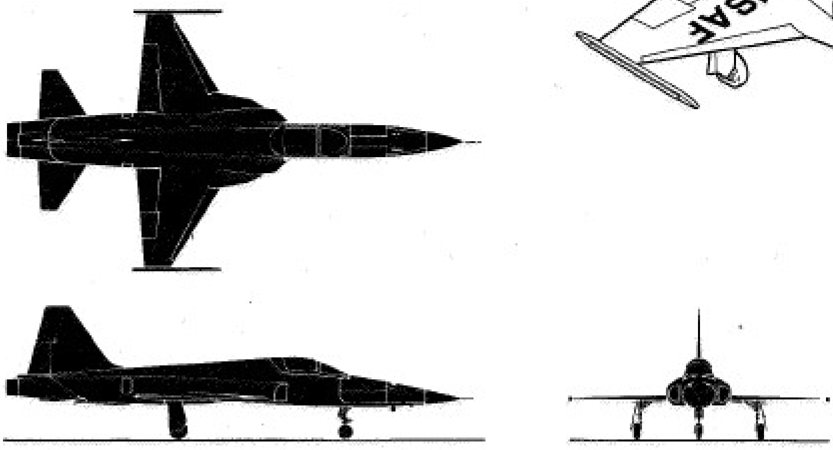
TACTICAL FIGHTER





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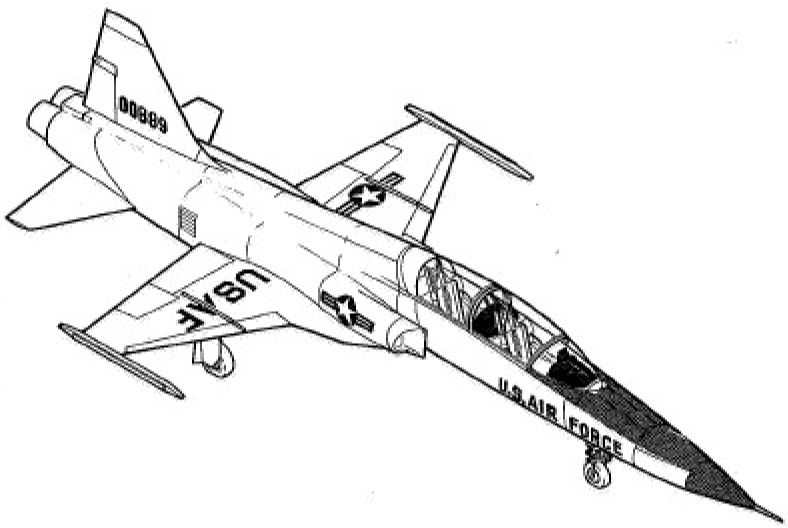
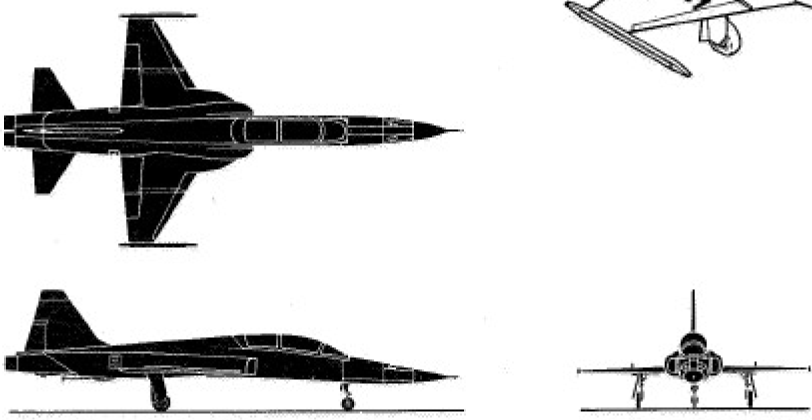
TACTICAL FIGHTER/TRAINER





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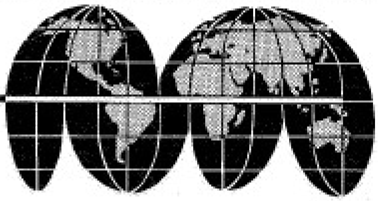
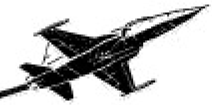


DESCRIPTION AND OPERATION

SECTION I



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THE AIRCRAFT

The Ⓔ single-place and the Ⓕ two-place high-performance, multipurpose tactical fighters are produced by the Northrop Corporation, Aircraft Group. In addition to twin-engine reliability, the aircraft are capable of supersonic flight. Similarity of operating procedures and flight characteristics will allow a pilot qualified in either aircraft to fly the other with a minimum of training. The Ⓕ rear cockpit is equipped with dual controls and instrumentation to allow the aircraft to be used as a pilot trainer or dual-piloted fighter-bomber; however, minimum crew requirement is one pilot. Thrust is provided by two turbojet engines equipped with afterburners. An automatic auxiliary intake door on each side of the fuselage above the wing trailing edge provides additional air to the engines during takeoff and low-speed flight. The fuselage is an area-rule (coke-bottle) shape. The wing, horizontal tail, and vertical stabilizer are moderately sweptback. The Ⓕ wing is fitted with "wing fences" to improve boundary layer control. Each wing is equipped with leading and trailing edge flaps used for takeoff, landing, cruise, and maneuvering flight. The maneuvering flap position provides automatic control of flap position by the central air data computer (CADC). Deceleration equipment includes a speed brake under the central fuselage, a drag chute to decrease landing roll, and an arresting hook under the aft fuselage for emergency stopping. The tricycle landing gear has a steerable nosewheel and a two-position extendable nose gear strut used for takeoff. Flight controls are hydraulically actuated by two independent hydraulic systems equipped with artifical feel devices to simulate feel to the pilot. The cockpit(s) are enclosed by manually-operated clamshell canopy(ies). Fuel cells are in the fuselage, with additional fuel carried in external tanks. The fire control system includes a fire control radar with search and range tracking capability, a lead computing optical sight, and a sight camera. Basic armament includes two 20mm guns in the nose (Ⓕ left gun only), and air-to-air missile on each wingtip. Additional weapons consisting of various bombs, rockets, and flares are carried on five jettisonable pylons.

AIRCRAFT DIMENSIONS

The overall dimensions of the aircraft with normal tire and strut inflation are:

	Ⓔ	Ⓕ
Length	48 ft 2 in	51 ft 8 in
Wingspan (with wingtip launcher rails)	26 ft 8 in	26 ft 8 in
Height	13 ft 4 in	13 ft 2 in
Tread	12 ft 6 in	12 ft 6 in
Wheelbase	16 ft 11 in	21 ft 2 in

See section II for turning radius and ground clearance.

AIRCRAFT GROSS WEIGHT

The average gross weights, including pilot (one pilot Ⓕ), full internal fuel (JP-4), oil and no ammunition, are as follows:

	Ⓔ	Ⓕ
With wingtip launcher rails (no pylons)	15,050 lb	15,650 lb
With wingtip launcher rails and full centerline 275-gallon tank	17,250 lb	17,850 lb

The above gross weights shall not be used for mission planning. For exact aircraft gross weight, refer to the current Form 365F for the aircraft to be flown.

AIRCRAFT DIFFERENCES

The aircraft main differences table (figure 1-1) lists various avionics systems, fire control systems, flight instruments, and ejection seats. To determine the equipment description and procedures applicable to a particular aircraft, locate the aircraft serial number and code in the aircraft designation codes listed in the foreword section of this manual and enter the differences table with the appropriate code. Descriptions and procedures not applicable to the aircraft may be disregarded. See figure 1-2 for a typical aircraft general arrangement, and figures 1-3 thru 1-29 for typical cockpit arrangements.

MAIN DIFFERENCES TABLE

SYSTEM/ITEM	AIRCRAFT CODE											
	E	E-1	E-2	E-3	E-4	E-5	E-6	E-7	F	F-1	F-2	F-3
ALTIMETERS												
AAU-7A/A	●		●	●	●		●					
AAU-19/A	●					●		●	●		●	●
AAU-34/A		●								●		
HEADING & NAVIGATION												
AQU-10/A	●		●	●	●	●	●	●				
AQU-13/A	●		●	●	●	●	●		●			
AQU-13A/A	●	●	●		●		●	●		●	●	●
STANDBY ATTITUDE INDICATOR												
ARU-32/A	●		●	●	●	●	●	●				
ARU-42/A-1		●							●	●	●	●
UHF RADIO												
ARC-150	●		●	●	●	●			●			●
ARC-164	●	●	●		●	●	●	●		●	●	
TACAN												
ARN-65	●				●							
ARN-84			●	●		●			●			
ARN-118	●	●			●		●	●		●	●	●
SKYSPOT												
SST-181	●		●			●	●		●		* ●	
EJECTION SEAT												
STANDARD	●		●	●	●	●	●					
IMPROVED		●						●	●	●	●	●
SURVIVAL KIT												
STANDARD	●		●	●	●	●	●					
IMPROVED		●						●	●	●	●	●
RADAR												
AN/APQ-153	●		●	●	●	●	●	●				
AN/APQ-157									●		●	●
AN/APQ-159(V)-3		●										
AN/APQ-159(V)-4										●		
OPTICAL SIGHT												
AN/ASG-29	●		●	●	●	●	●	●	●		●	●
AN/ASG-31		●								●		

* SOME AIRCRAFT

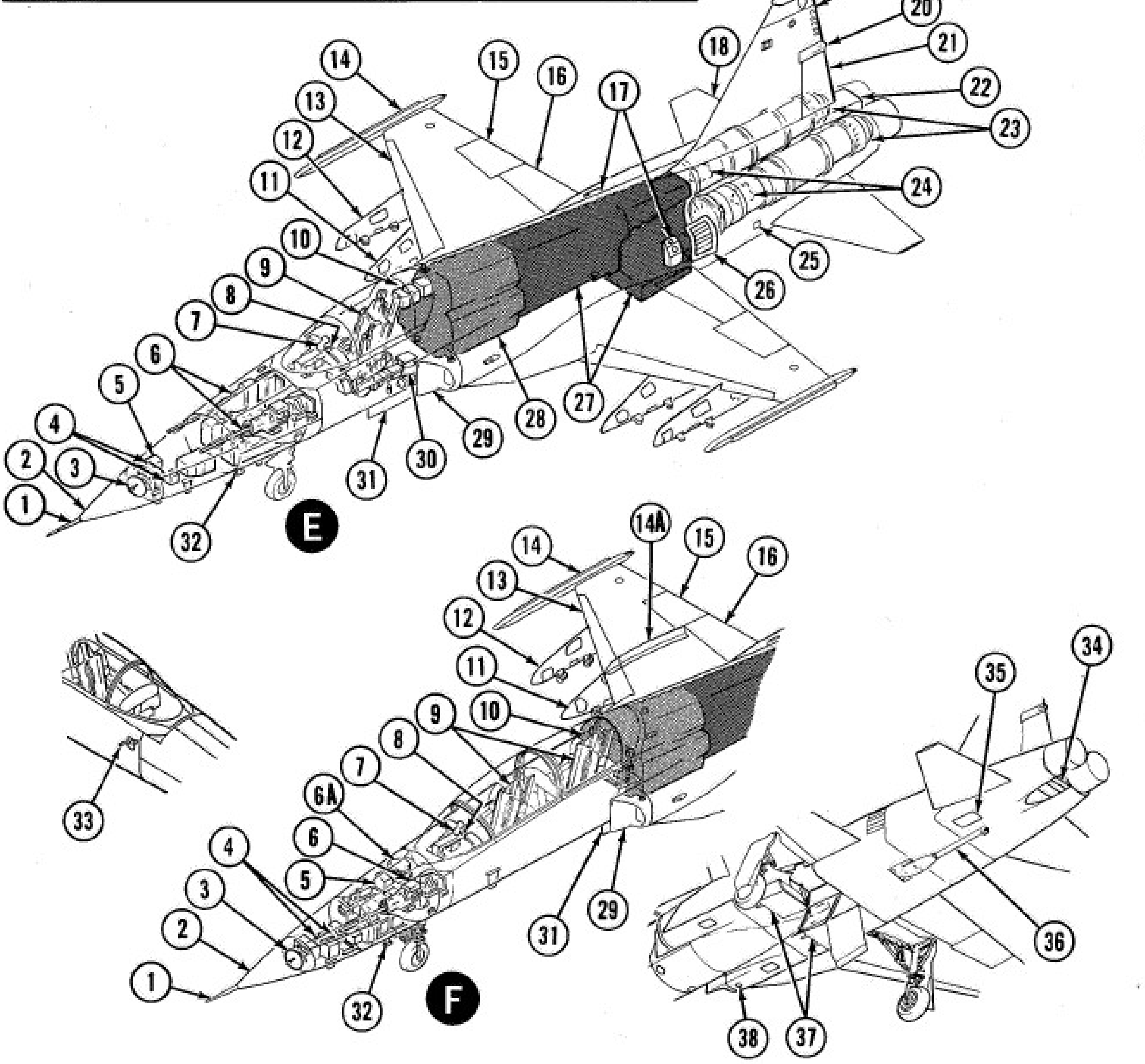
Note

SEE FOREWORD FOR AIRCRAFT CODE EFFECTIVITIES

F-5 1-157(1)G

Figure 1-1.

GENERAL ARRANGEMENT (TYPICAL)



1 PITOT-STATIC BOOM
2 RADOME
3 RADAR ANTENNA
4 AVIONICS EQUIPMENT BAYS
5 BATTERY
6 GUNS (F LEFT ONLY)
6A LIQUID OXYGEN CONVERTER F
7 COMPUTING OPTICAL SIGHT
8 SIGHT CAMERA (ON SIGHT)
9 EJECTION SEAT
10 ELECTRICAL EQUIPMENT BAY
11 INBOARD PYLON
12 OUTBOARD PYLON
13 LEADING EDGE FLAP
14 LAUNCHER RAIL
14A WING FENCE (BOTH SIDES) F
15 AILERON
16 TRAILING EDGE FLAP
17 HYDRAULIC RESERVOIRS
18 HORIZONTAL TAIL
19 VERTICAL STABILIZER
20 FUEL VENT
21 RUDDER
22 DRAG CHUTE COMPARTMENT
23 ENGINES
24 ENGINE OIL RESERVOIRS
25 EXTERNAL ELECTRICAL RECEPTACLE
26 ENGINE AUXILIARY AIR INTAKE DOOR (EACH SIDE)
27 R FUEL (AFT) SYSTEM CELLS
28 L FUEL (FWD) SYSTEM CELL
29 ENGINE AIR INLET DUCT (EACH SIDE)
30 LIQUID OXYGEN CONVERTER E
31 CENTERLINE PYLON
32 TOTAL TEMPERATURE PROBE
33 AOA VANE TRANSMITTER
34 EXTERNAL TAIL BALLAST – TOTAL 4 PIECES (VARIABLE) F
35 ENGINE STARTER AIR INLET
36 ARRESTING HOOK
37 SPEED BRAKE
38 INTERPHONE RECEPTACLE (GROUND CREW TO PILOT)

F-5 1-20(1)C

Figure 1-2.

COCKPIT ARRANGEMENT (TYPICAL)

E EXCEPT E-1

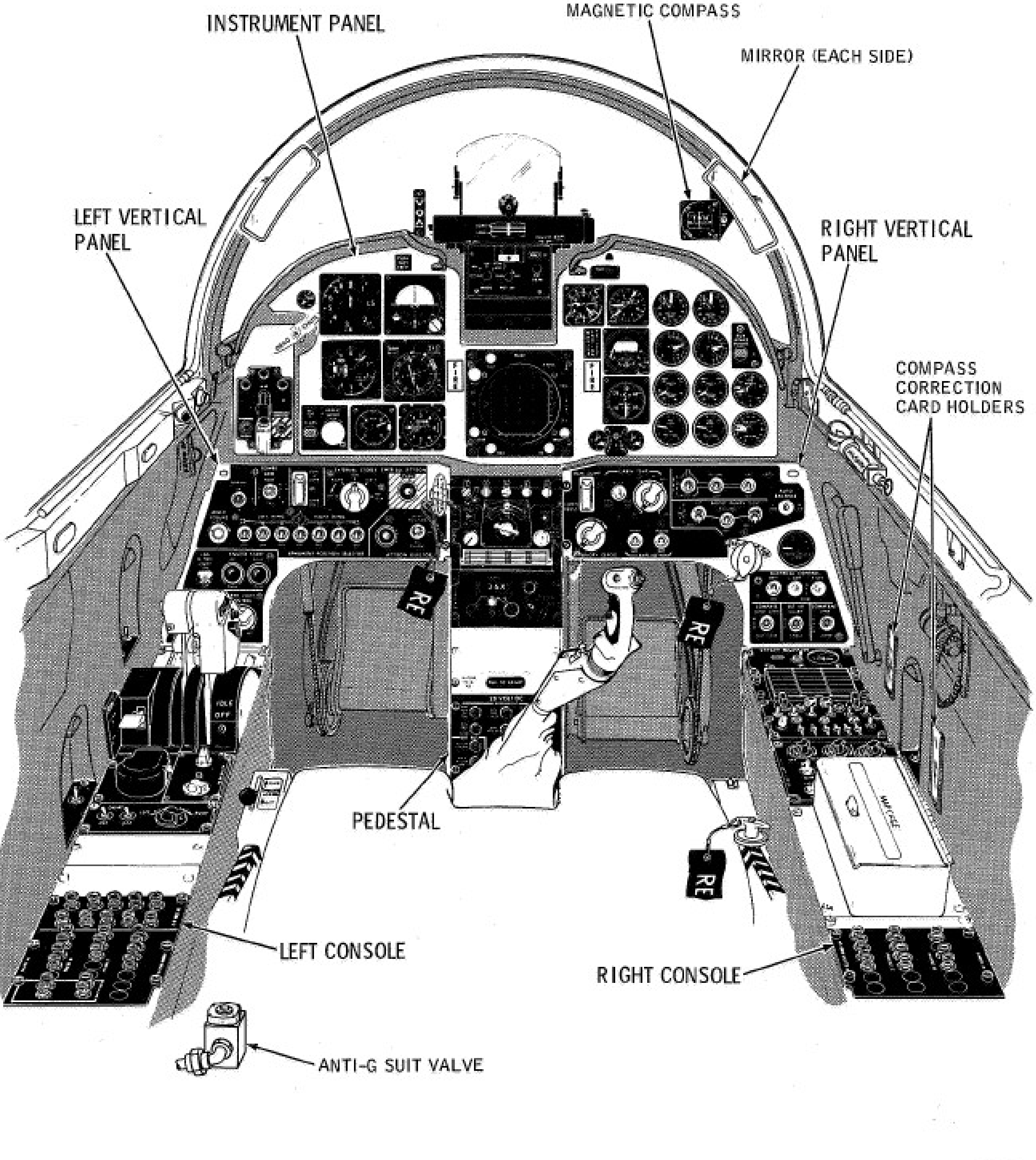


Figure 1-3.

COCKPIT ARRANGEMENT - FRONT (TYPICAL) F EXCEPT F-1

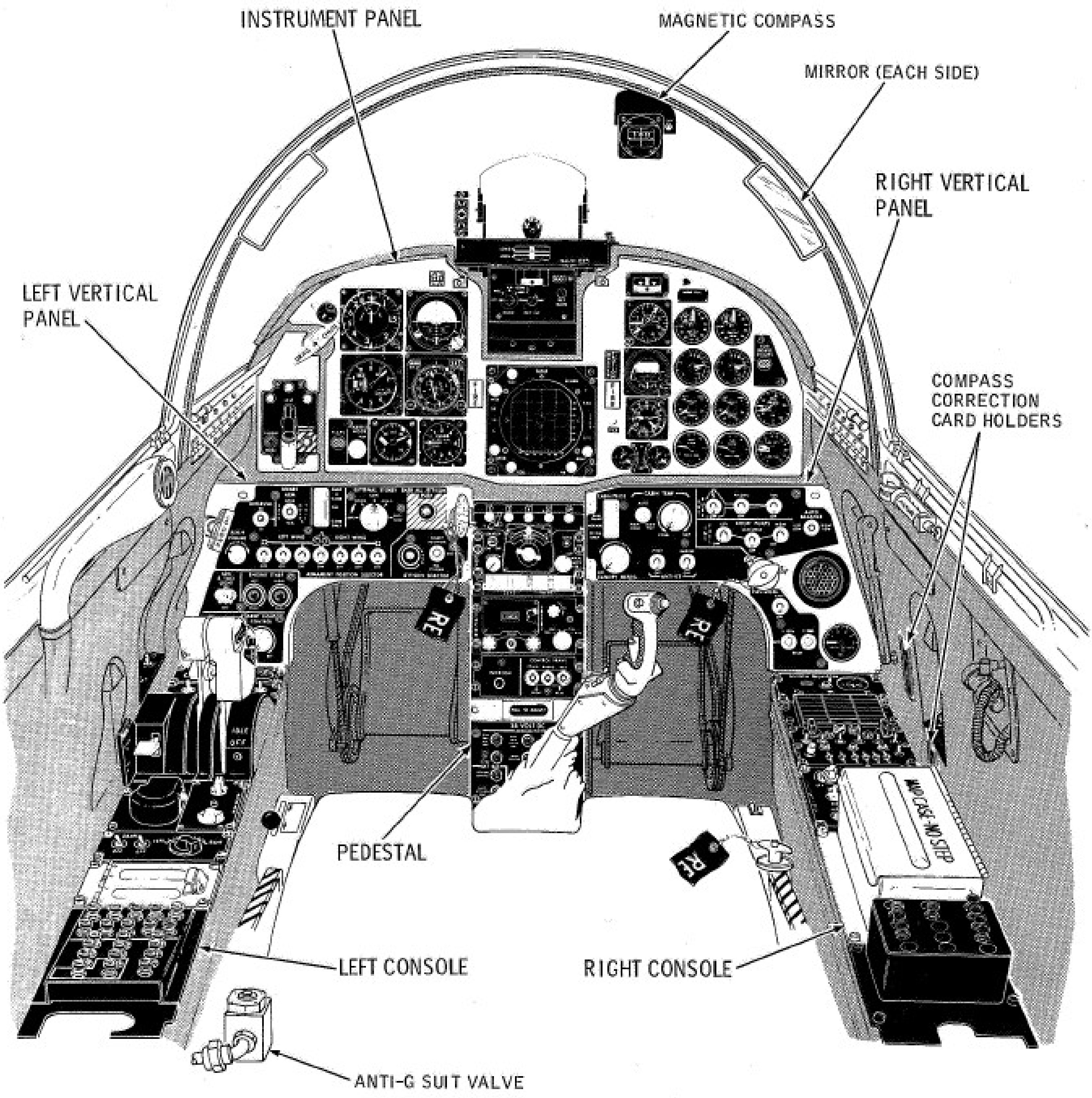


Figure 1-4.

COCKPIT ARRANGEMENT – REAR (TYPICAL)

F EXCEPT F-1

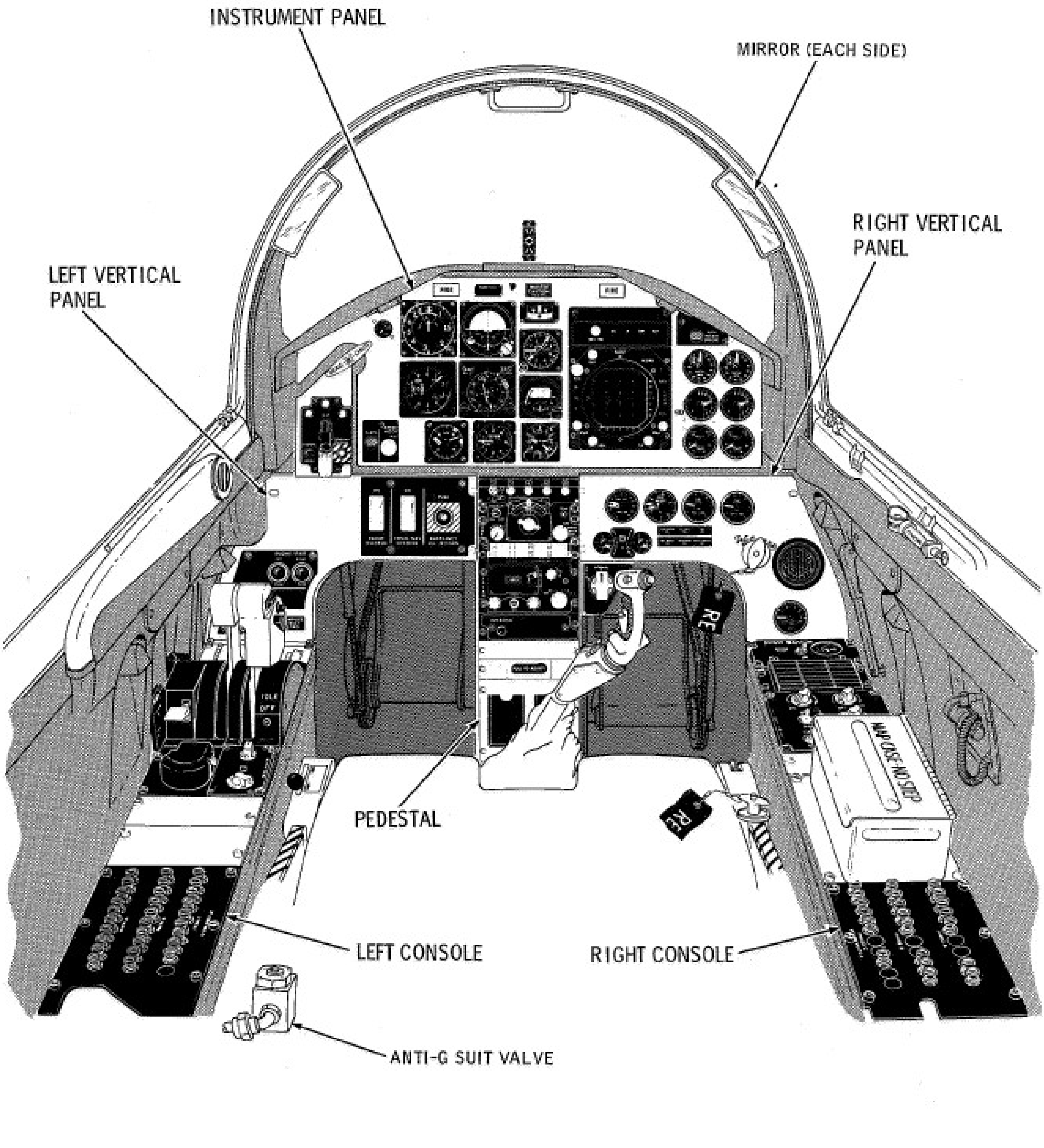


Figure 1-5.

COCKPIT ARRANGEMENT

E-1

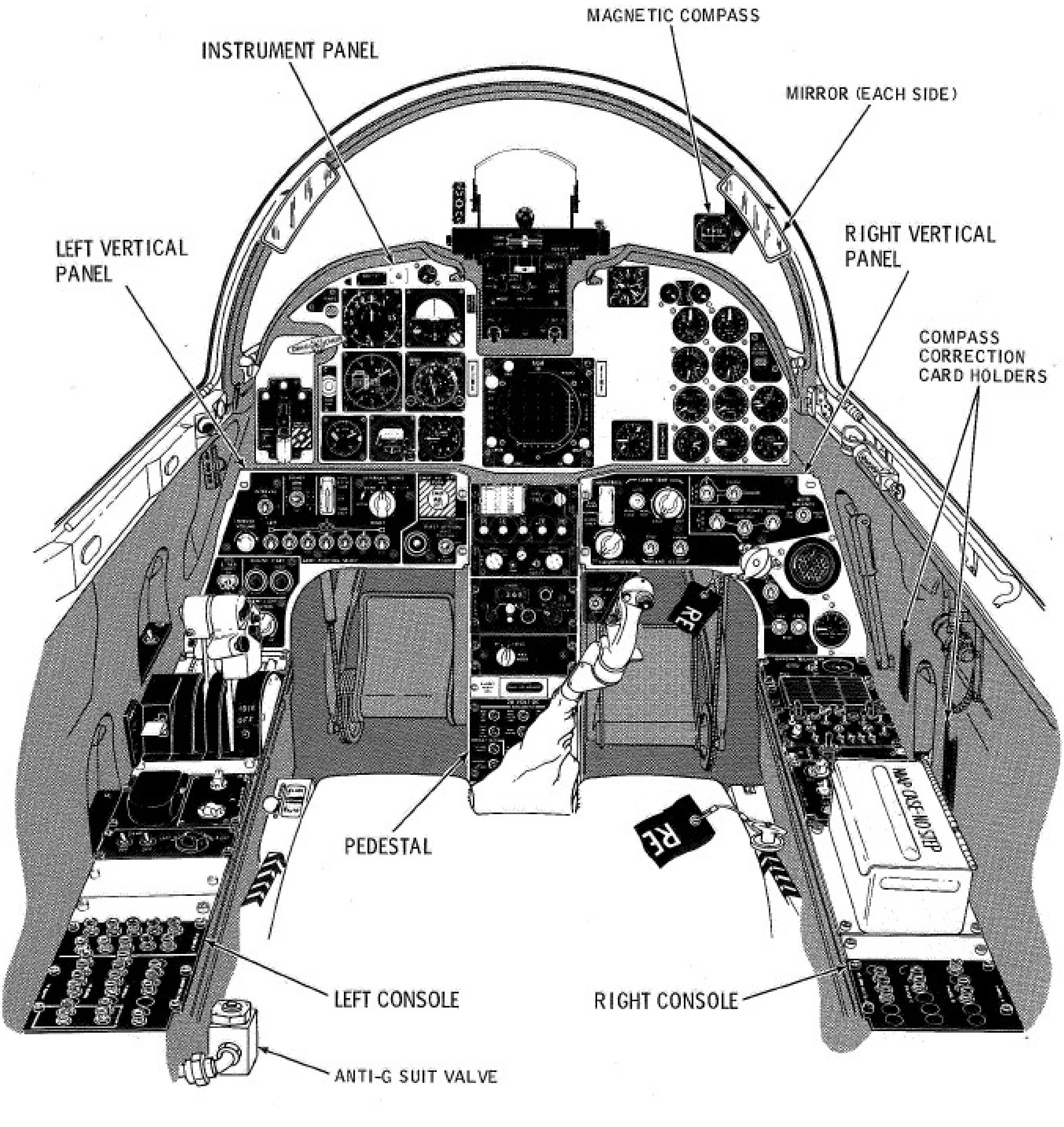


Figure 1-6.

COCKPIT ARRANGEMENT - FRONT

F-1

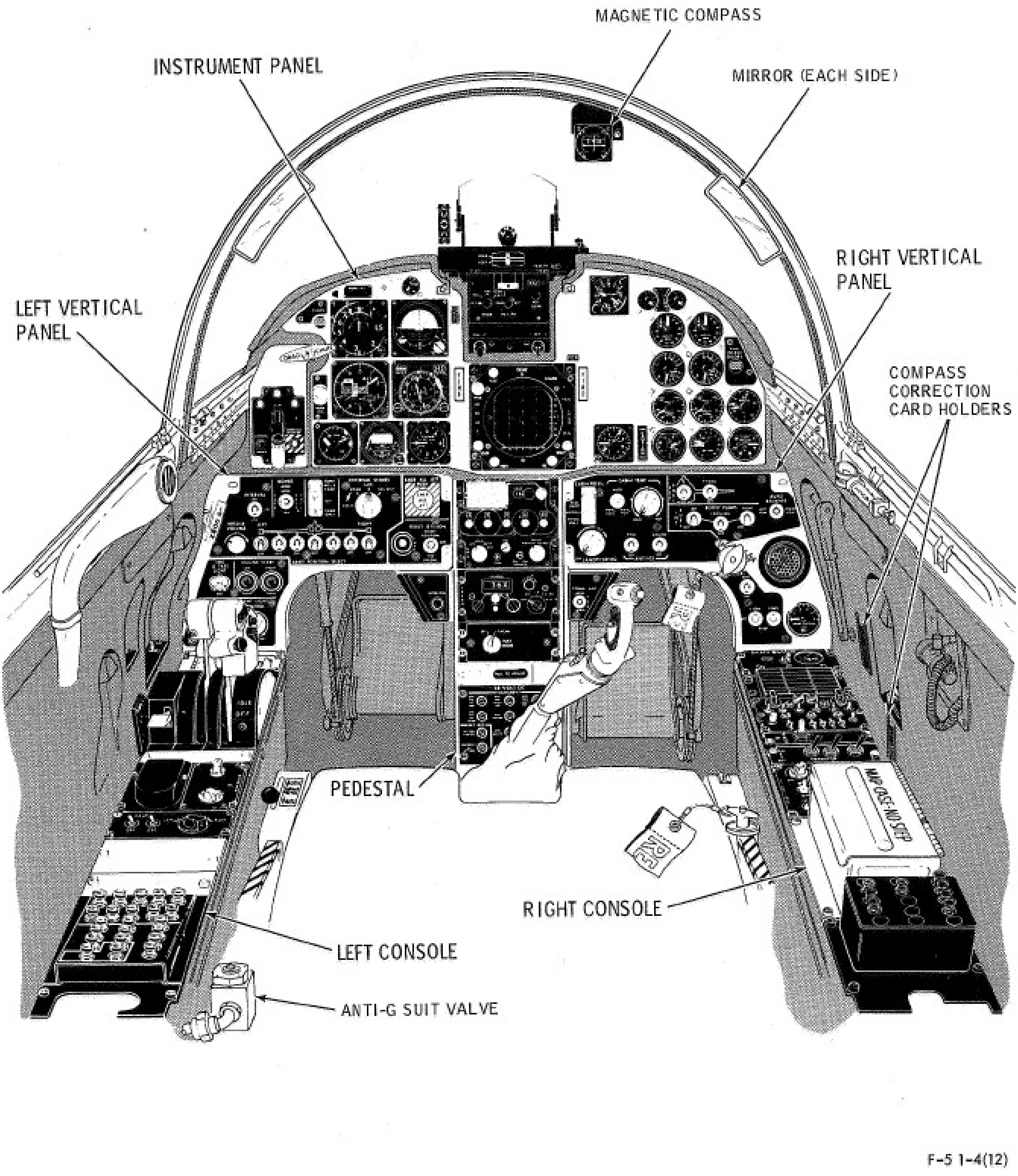


Figure 1-7.

COCKPIT ARRANGEMENT-REAR

F-1

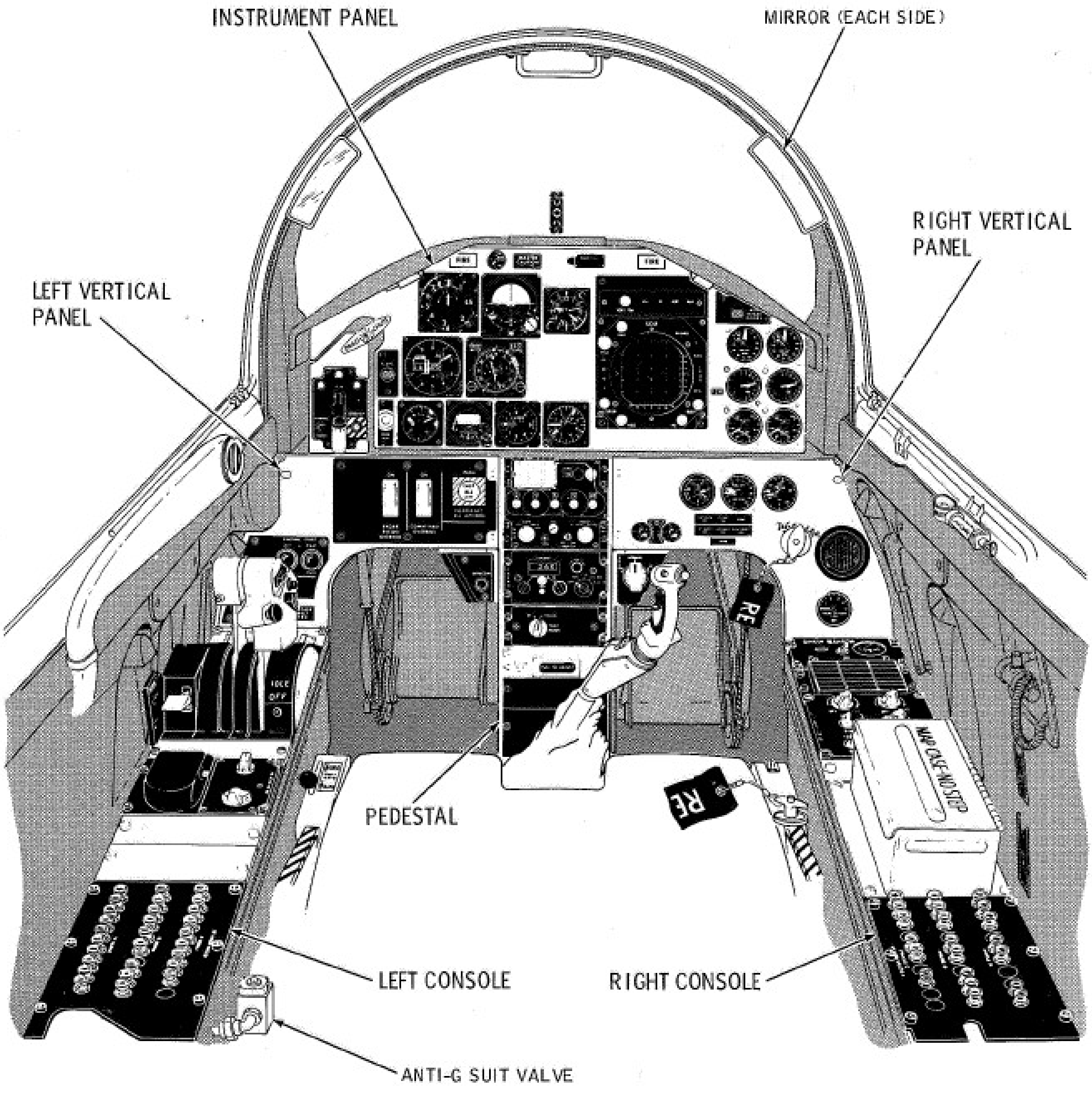
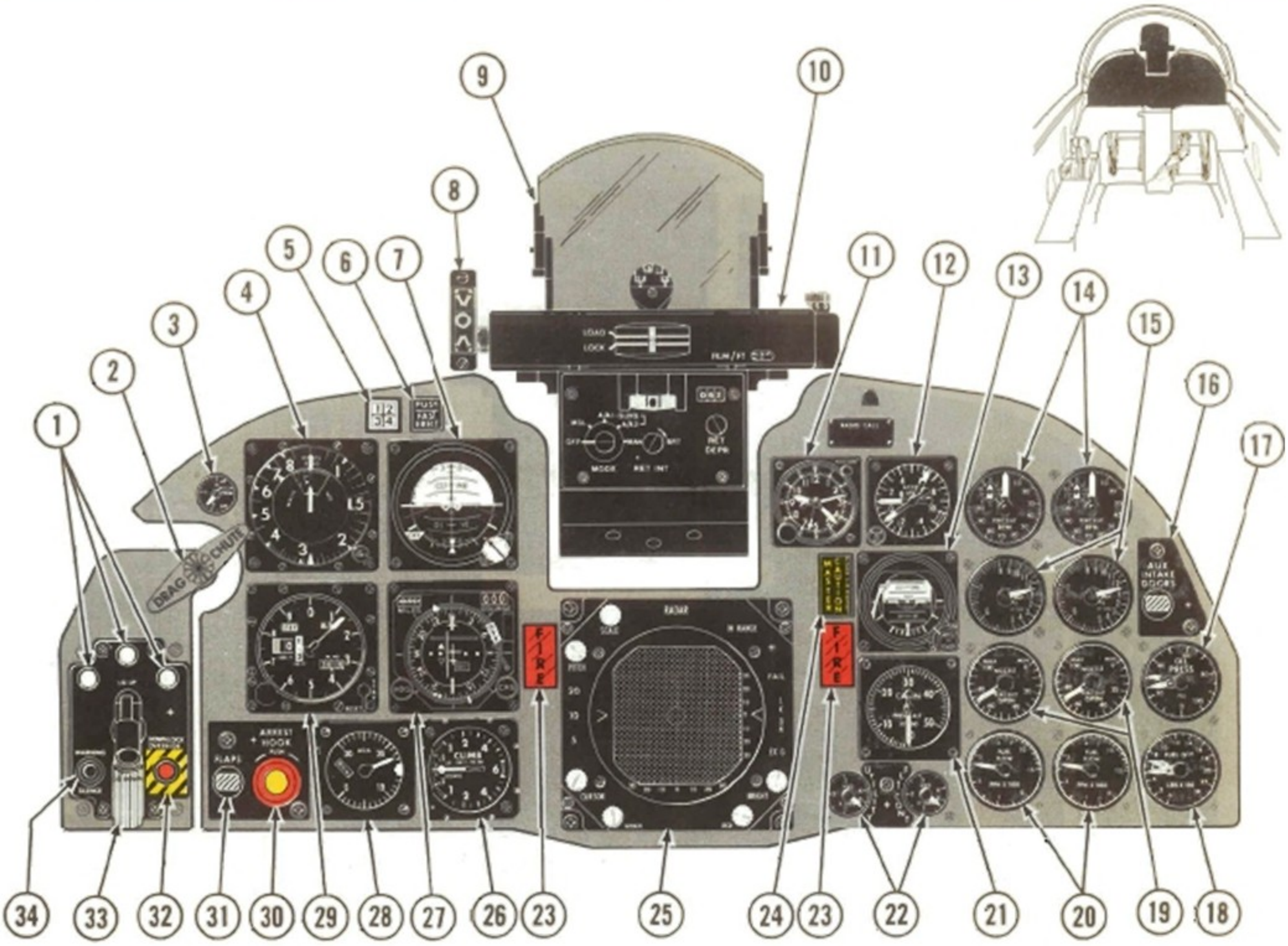


Figure 1-8.

INSTRUMENT PANEL (TYPICAL)

E EXCEPT E-1



1 LANDING GEAR POSITION INDICATOR LIGHTS
2 DRAG CHUTE HANDLE
3 PITCH TRIM INDICATOR
4 AIRSPEED-MACH INDICATOR
5 CAMERA OPERATE LIGHTS (W/RECON NOSE)
6 ATTITUDE INDICATOR FAST-ERECT SWITCH
7 ATTITUDE INDICATOR
8 ANGLE-OF-ATTACK INDEXER
9 COMPUTING OPTICAL SIGHT
10 SIGHT CAMERA
11 CLOCK
12 ACCELEROMETER
13 STANDBY ATTITUDE INDICATOR
14 ENGINE TACHOMETERS
15 EXHAUST GAS TEMPERATURE INDICATORS
16 AUXILIARY INTAKE DOORS INDICATOR
17 OIL PRESSURE INDICATOR (DUAL)
18 FUEL QUANTITY INDICATOR (DUAL)
19 NOZZLE POSITION INDICATORS
20 FUEL FLOW INDICATORS
21 CABIN PRESSURE ALTIMETER
22 HYDRAULIC PRESSURE INDICATORS
23 FIRE WARNING LIGHT
24 MASTER CAUTION LIGHT
25 RADAR INDICATOR (W/O RECON NOSE)
26 VERTICAL VELOCITY INDICATOR
27 HORIZONTAL SITUATION INDICATOR
28 ANGLE-OF-ATTACK INDICATOR
29 ALTIMETER
30 ARRESTING HOOK BUTTON
31 FLAP POSITION INDICATOR
32 LANDING GEAR DOWNLOCK OVERRIDE BUTTON
33 LANDING GEAR LEVER
34 LANDING GEAR AND FLAP WARNING SILENCE BUTTON

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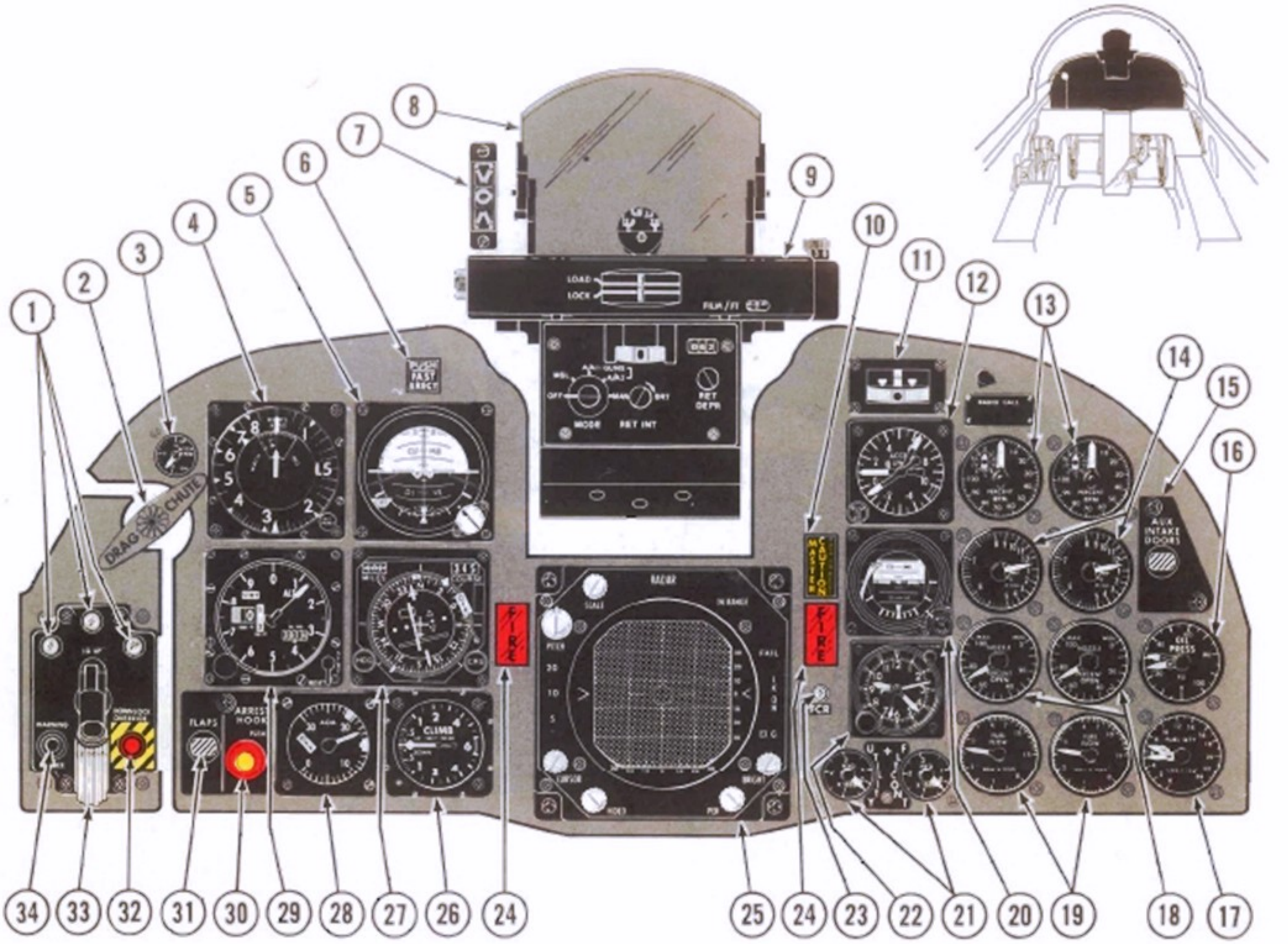
Figure 1-9.

INSTRUMENT PANEL–FRONT (TYPICAL)

F EXCEPT F-1



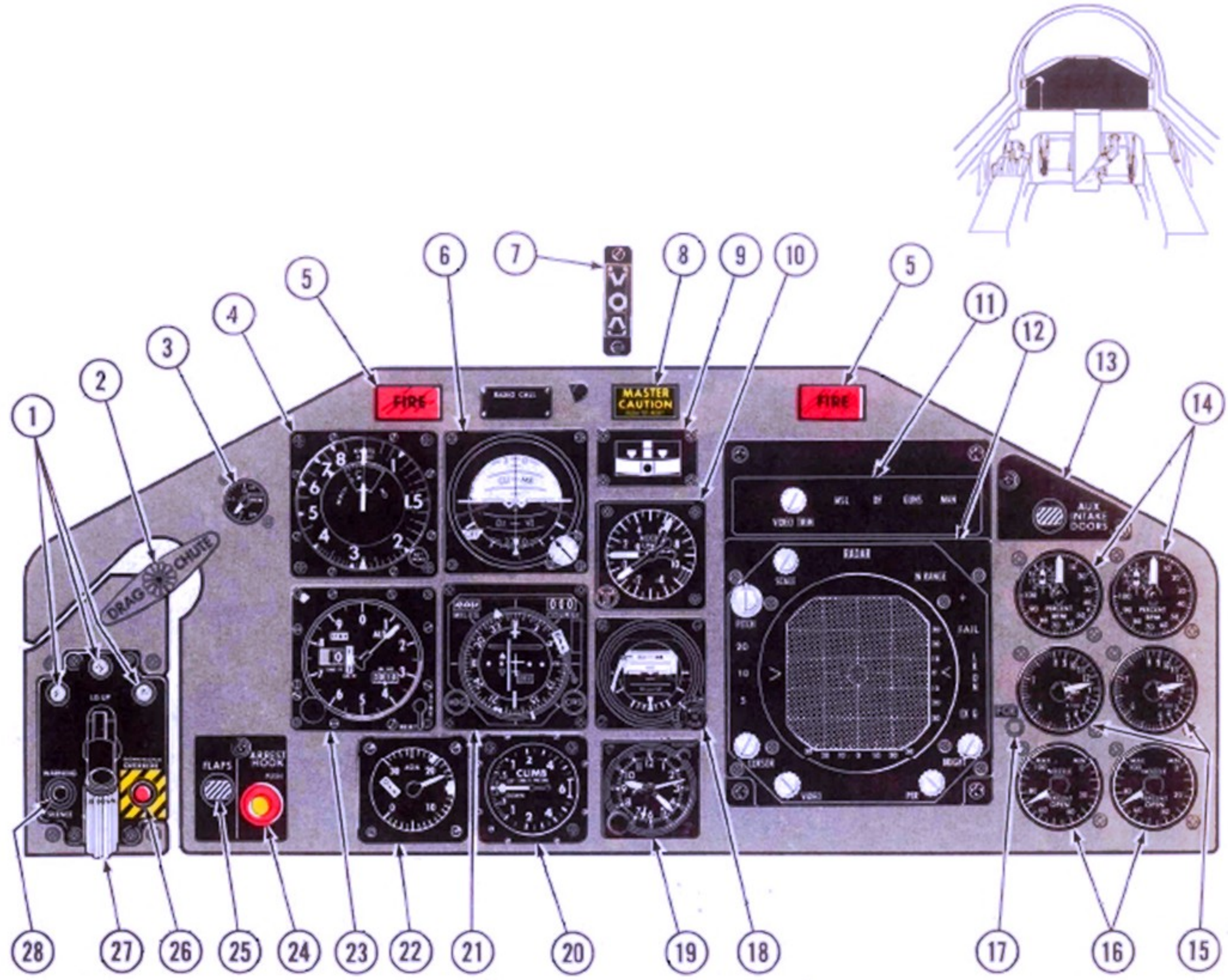
1 LANDING GEAR POSITION INDICATOR LIGHTS
2 DRAG CHUTE HANDLE
3 PITCH TRIM INDICATOR
4 AIRSPEED-MACH INDICATOR
5 ATTITUDE INDICATOR
6 ATTITUDE INDICATOR FAST ERECT SWITCH
7 ANGLE-OF-ATTACK INDEXER
8 COMPUTING OPTICAL SIGHT
9 SIGHT CAMERA
10 MASTER CAUTION LIGHT
11 TURN-SLIP INDICATOR
12 ACCELEROMETER
13 ENGINE TACHOMETERS
14 EXHAUST GAS TEMPERATURE INDICATORS
15 AUXILIARY INTAKE DOORS INDICATOR
16 OIL PRESSURE INDICATOR (DUAL)
17 FUEL QUANTITY INDICATOR (DUAL)
18 NOZZLE POSITION INDICATORS
19 FUEL FLOW INDICATORS
20 STANDBY ATTITUDE INDICATOR
21 HYDRAULIC PRESSURE INDICATORS
22 CLOCK
23 RADAR CONTROL INDICATOR LIGHT
24 FIRE WARNING LIGHT
25 RADAR INDICATOR
26 VERTICAL VELOCITY INDICATOR
27 HORIZONTAL SITUATION INDICATOR
28 ANGLE-OF-ATTACK INDICATOR
29 ALTIMETER
30 ARRESTING HOOK BUTTON
31 FLAP POSITION INDICATOR
32 LANDING GEAR DOWNLOCK OVERRIDE BUTTON
33 LANDING GEAR LEVER
34 LANDING GEAR AND FLAP WARNING SILENCE BUTTON

F-5 1-8(2)E

Figure 1-10.

INSTRUMENT PANEL - REAR (TYPICAL)

F EXCEPT F-1



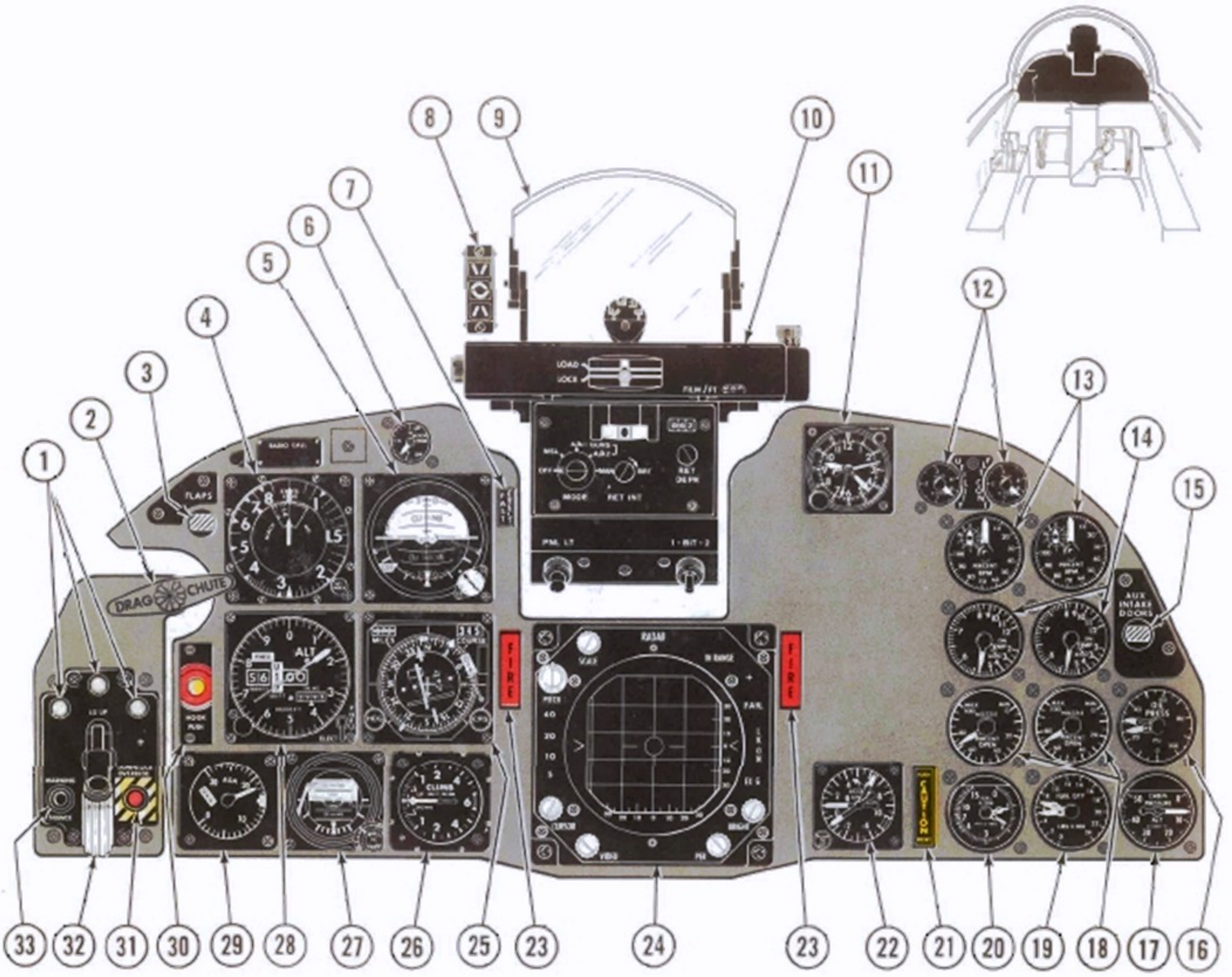
1 LANDING GEAR POSITION INDICATOR LIGHTS
2 DRAG CHUTE HANDLE
3 PITCH TRIM INDICATOR
4 AIRSPEED-MACH INDICATOR
5 FIRE WARNING LIGHT
6 ATTITUDE INDICATOR
7 ANGLE-OF-ATTACK INDEXER
8 MASTER CAUTION LIGHT
9 TURN-SLIP INDICATOR
10 ACCELEROMETER
11 RADAR VIDEO TRIM/FIRE CONTROL SYSTEM MODE INDICATOR LIGHTS
12 RADAR INDICATOR
13 AUXILIARY INTAKE DOORS INDICATOR
14 ENGINE TACHOMETERS
15 EXHAUST GAS TEMPERATURE INDICATORS
16 NOZZLE POSITION INDICATORS
17 RADAR CONTROL INDICATOR LIGHT
18 STANDBY ATTITUDE INDICATOR
19 CLOCK
20 VERTICAL VELOCITY INDICATOR
21 HORIZONTAL SITUATION INDICATOR
22 ANGLE-OF-ATTACK INDICATOR
23 ALTIMETER
24 ARRESTING HOOK BUTTON
25 FLAP POSITION INDICATOR
26 LANDING GEAR DOWNLOCK OVERRIDE BUTTON
27 LANDING GEAR LEVER
28 LANDING GEAR AND FLAP WARNING SILENCE BUTTON

F-5 1-10(1)D

Figure 1-11.

INSTRUMENT PANEL

E-1



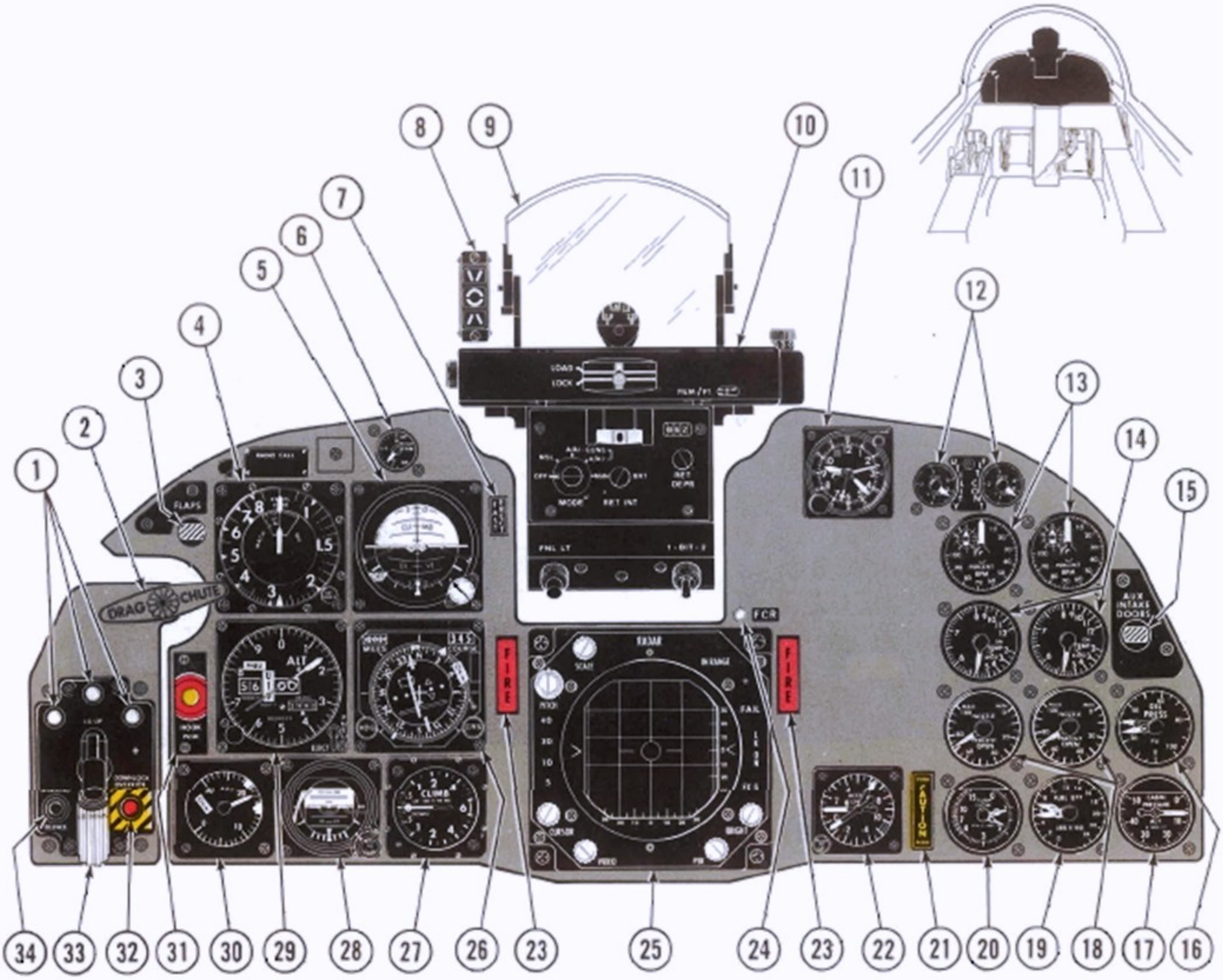
1	LANDING GEAR POSITION INDICATOR LIGHTS	18	NOZZLE POSITION INDICATORS
2	DRAG CHUTE HANDLE	19	FUEL QUANTITY INDICATOR (DUAL)
3	FLAP POSITION INDICATOR	20	FUEL FLOW INDICATOR (DUAL)
4	AIRSPEED-MACH INDICATOR	21	MASTER CAUTION LIGHT
5	ATTITUDE INDICATOR	22	ACCELEROMETER
6	PITCH TRIM INDICATOR	23	FIRE WARNING LIGHT
7	ATTITUDE INDICATOR FAST-ERECT SWITCH	24	RADAR INDICATOR
8	ANGLE-OF-ATTACK INDEXER	25	HORIZONTAL SITUATION INDICATOR
9	COMPUTING OPTICAL SIGHT	26	VERTICAL VELOCITY INDICATOR
10	SIGHT CAMERA	27	STANDBY ATTITUDE INDICATOR
11	CLOCK	28	ALTIMETER
12	HYDRAULIC PRESSURE INDICATORS	29	ANGLE-OF-ATTACK INDICATOR
13	ENGINE TACHOMETERS	30	ARRESTING HOOK BUTTON
14	EXHAUST GAS TEMPERATURE INDICATORS	31	LANDING GEAR DOWNLOCK OVERRIDE BUTTON
15	AUXILIARY INTAKE DOORS INDICATOR	32	LANDING GEAR LEVER
16	OIL PRESSURE INDICATOR (DUAL)	33	LANDING GEAR AND FLAP WARNING SILENCE BUTTON
17	CABIN PRESSURE ALTIMETER		

F-5 1-8(14)

Figure 1-12.

INSTRUMENT PANEL – FRONT

F-1



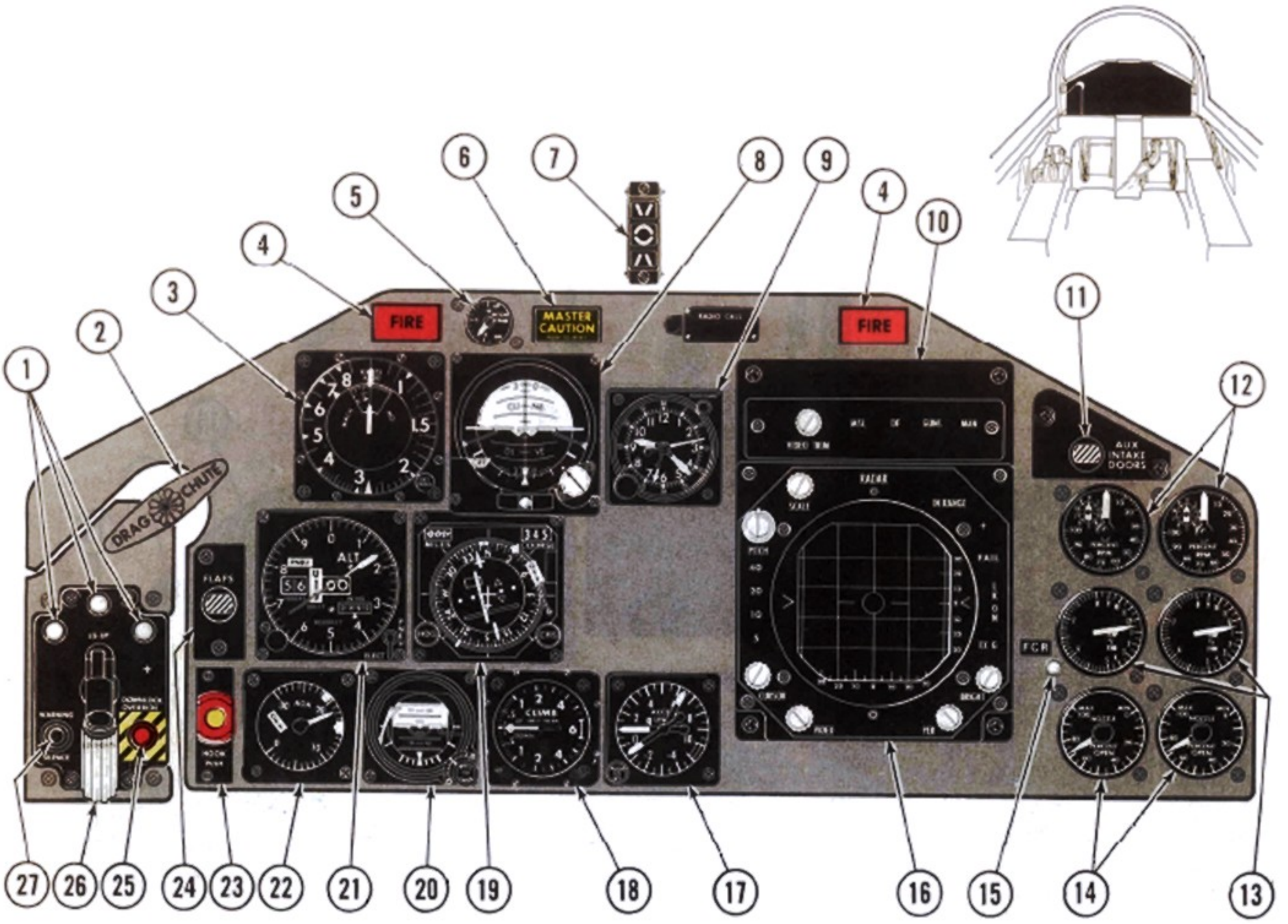
1 LANDING GEAR POSITION INDICATOR LIGHTS
2 DRAG CHUTE HANDLE
3 FLAP POSITION INDICATOR
4 AIRSPEED-MACH INDICATOR
5 ATTITUDE INDICATOR
6 PITCH TRIM INDICATOR
7 ATTITUDE INDICATOR FAST-ERECT SWITCH
8 ANGLE-OF-ATTACK INDEXER
9 COMPUTING OPTICAL SIGHT
10 SIGHT CAMERA
11 CLOCK
12 HYDRAULIC PRESSURE INDICATORS
13 ENGINE TACHOMETERS
14 EXHAUST GAS TEMPERATURE INDICATORS
15 AUXILIARY INTAKE DOORS INDICATOR
16 OIL PRESSURE INDICATOR (DUAL)
17 CABIN PRESSURE ALTIMETER
18 NOZZLE POSITION INDICATORS
19 FUEL QUANTITY INDICATOR (DUAL)
20 FUEL FLOW INDICATOR (DUAL)
21 MASTER CAUTION LIGHT
22 ACCELEROMETER
23 FIRE WARNING LIGHT
24 RADAR CONTROL INDICATOR LIGHT
25 RADAR INDICATOR
26 HORIZONTAL SITUATION INDICATOR
27 VERTICAL SITUATION INDICATOR
28 STANDBY ATTITUDE INDICATOR
29 ALTIMETER
30 ANGLE-OF-ATTACK INDICATOR
31 ARRESTING HOOK BUTTON
32 LANDING GEAR DOWNLOCK OVERRIDE BUTTON
33 LANDING GEAR LEVER
34 LANDING GEAR AND FLAP WARNING SILENCE BUTTON

F-5 1-8(13)

Figure 1-13.

INSTRUMENT PANEL - REAR

F-1



1 LANDING GEAR POSITION INDICATOR LIGHTS
2 DRAG CHUTE HANDLE
3 AIRSPEED-MACH INDICATOR
4 FIRE WARNING LIGHT
5 PITCH TRIM INDICATOR
6 MASTER CAUTION LIGHT
7 ANGLE-OF-ATTACK INDEXER
8 ATTITUDE INDICATOR
9 CLOCK
10 RADAR VIDEO TRIM/FIRE CONTROL SYSTEM MODE INDICATOR LIGHTS
11 AUXILIARY INTAKE DOORS INDICATOR
12 ENGINE TACHOMETERS
13 EXHAUST GAS TEMPERATURE INDICATORS
14 NOZZLE POSITION INDICATORS
15 RADAR CONTROL INDICATOR LIGHT
16 RADAR INDICATOR
17 ACCELEROMETER
18 VERTICAL VELOCITY INDICATOR
19 HORIZONTAL SITUATION INDICATOR
20 STANDBY ATTITUDE INDICATOR
21 ALTIMETER
22 ANGLE-OF-ATTACK INDICATOR
23 ARRESTING HOOK BUTTON
24 FLAP POSITION INDICATOR
25 LANDING GEAR DOWNLOCK OVERRIDE BUTTON
26 LANDING GEAR HANDLE
27 LANDING GEAR AND FLAP WARNING SILENCE BUTTON

F-5 1-10(7)A

Figure 1-14.

VERTICAL PANELS (TYPICAL)

E EXCEPT E-1

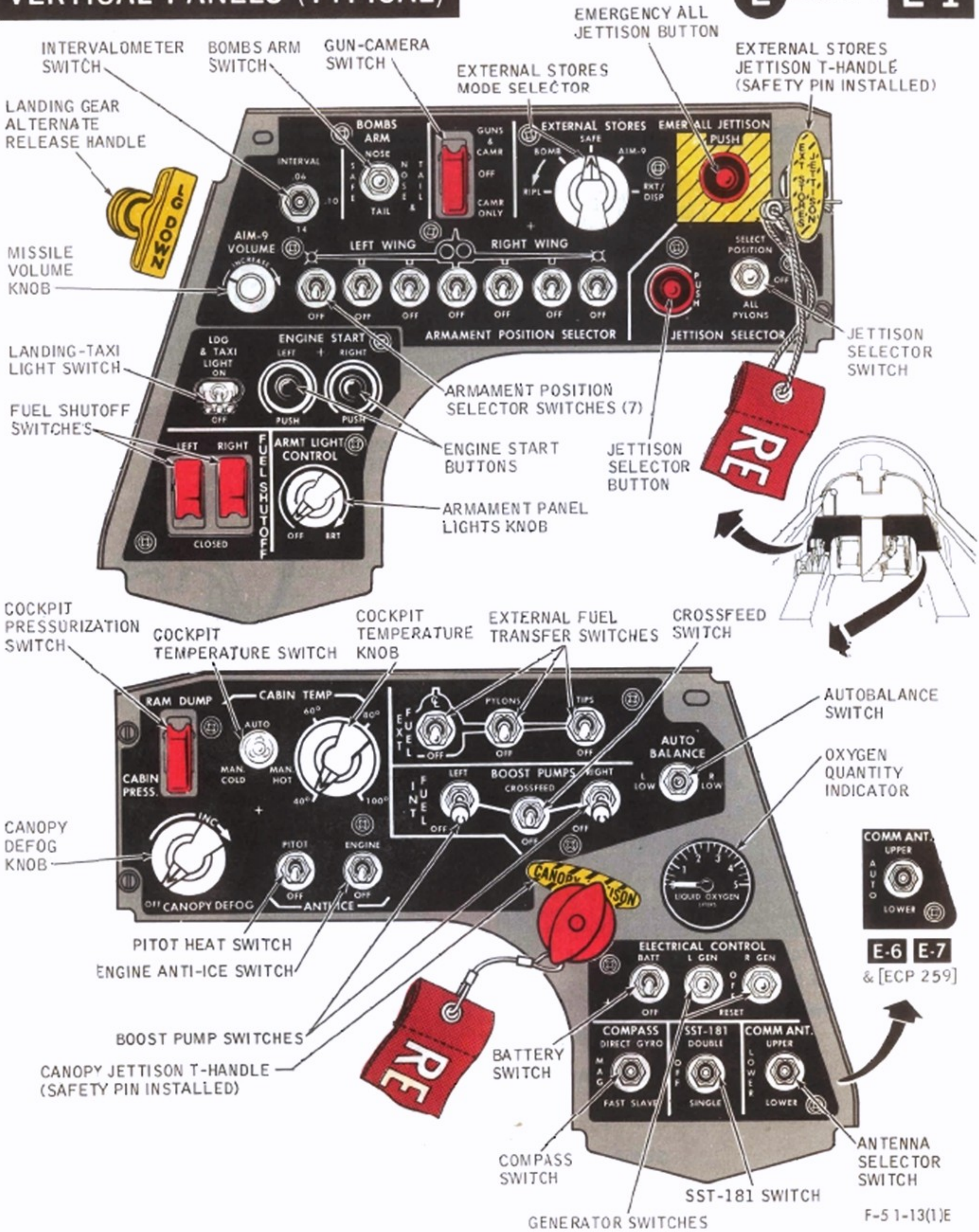


Figure 1-13.

VERTICAL PANELS - FRONT

F EXCEPT F-1

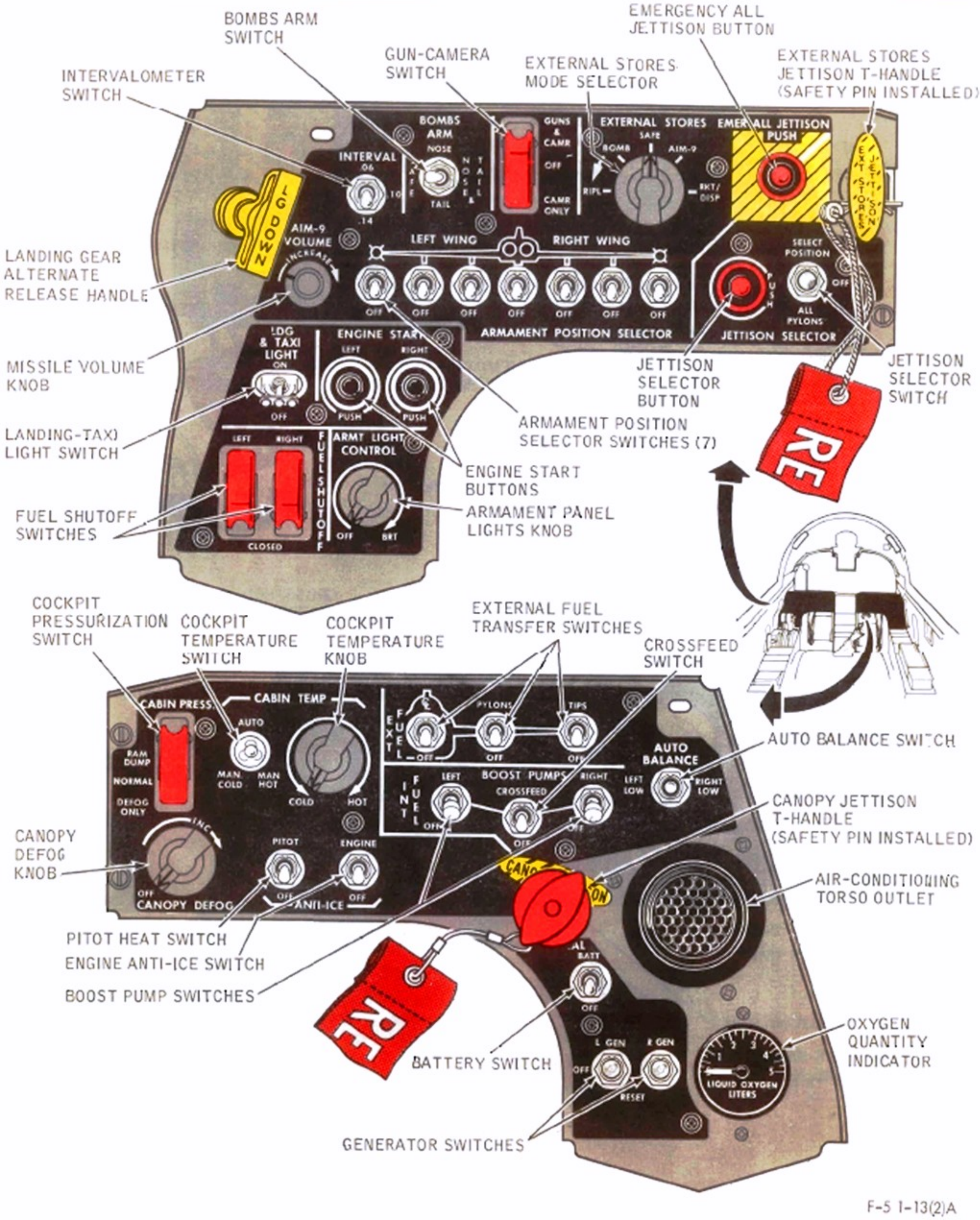


Figure 1-16.

VERTICAL PANELS-REAR

F EXCEPT F-1

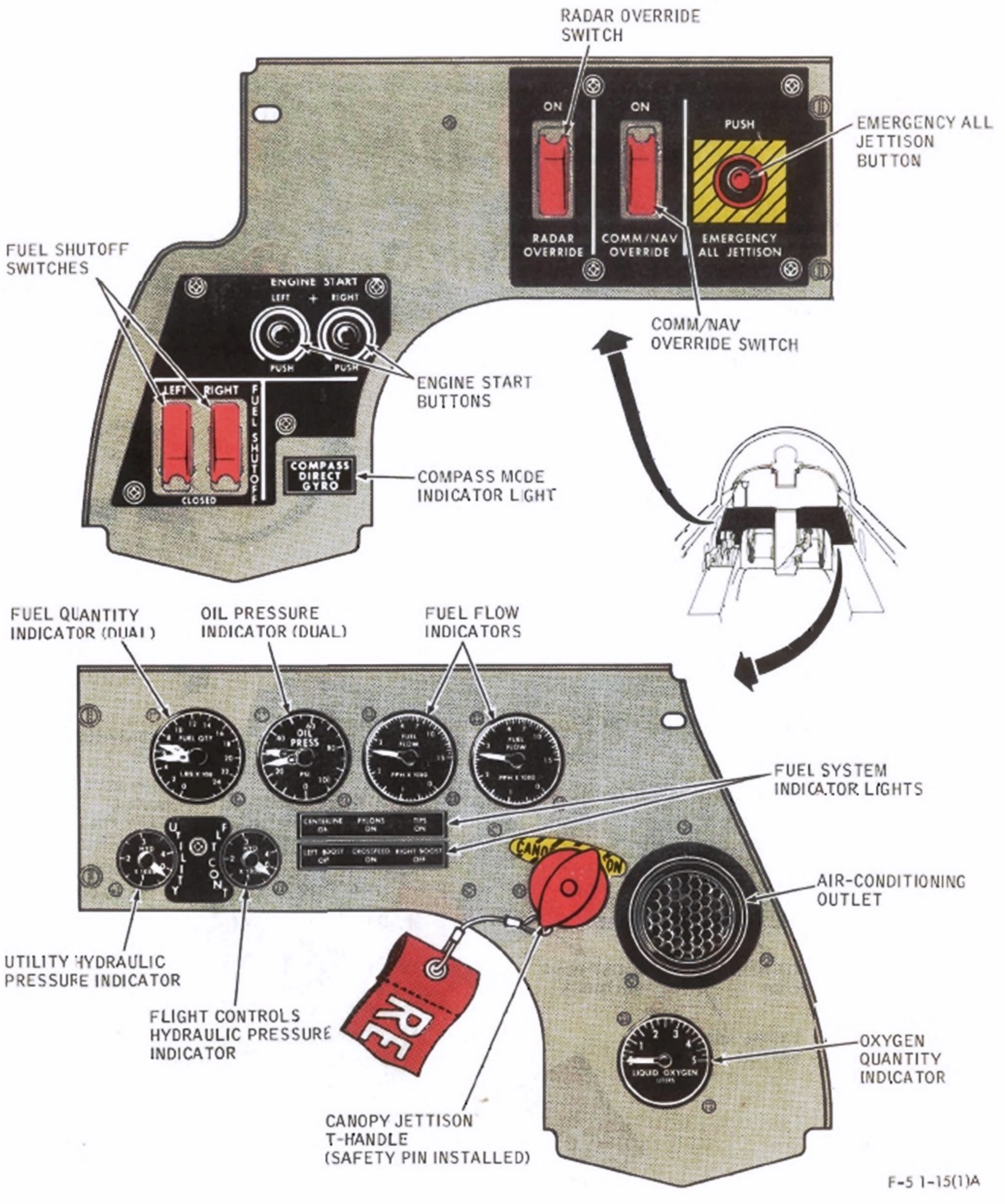


Figure 1-17.

VERTICAL PANELS

E-1

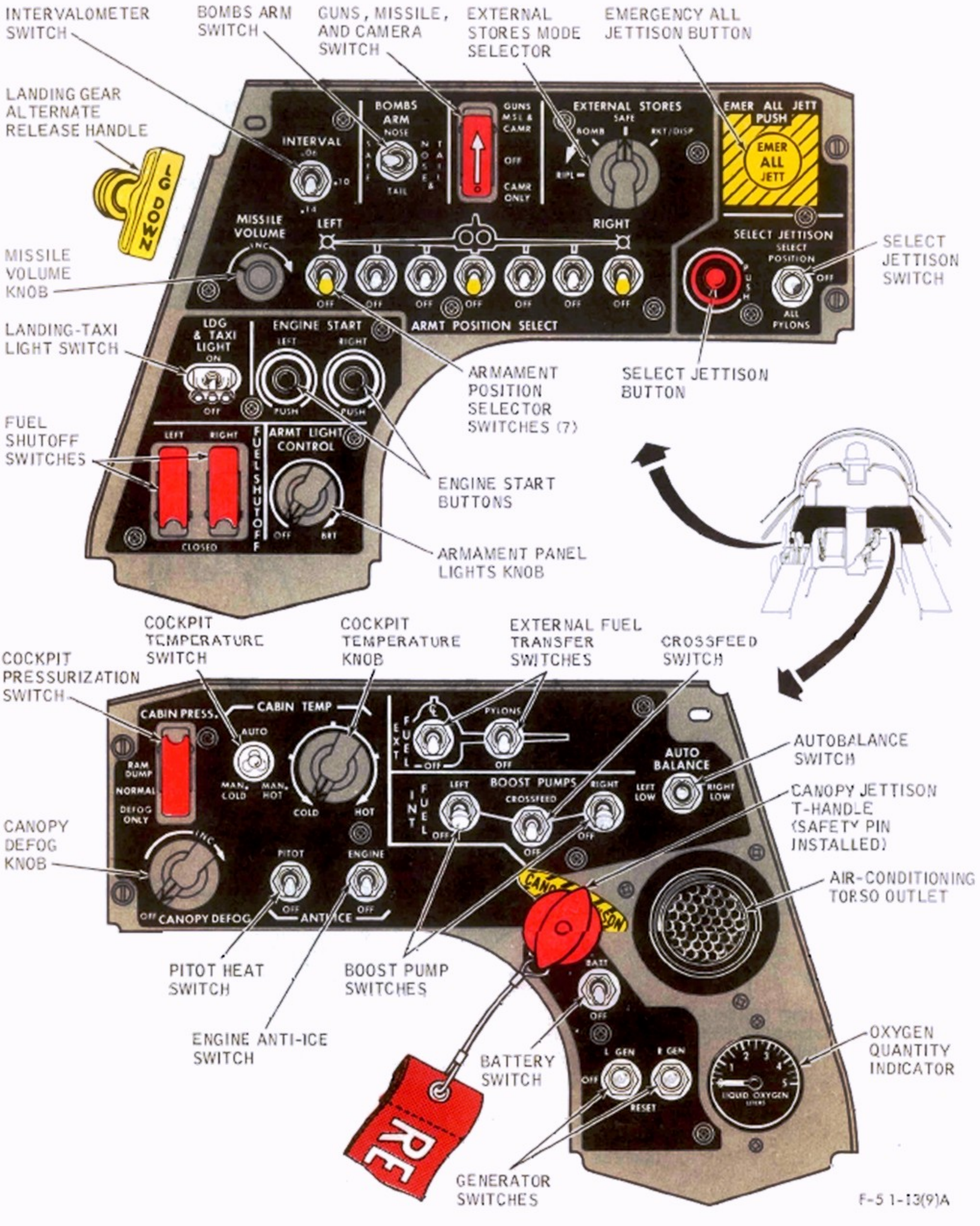


Figure 1-18.

VERTICAL PANELS—FRONT

F-1

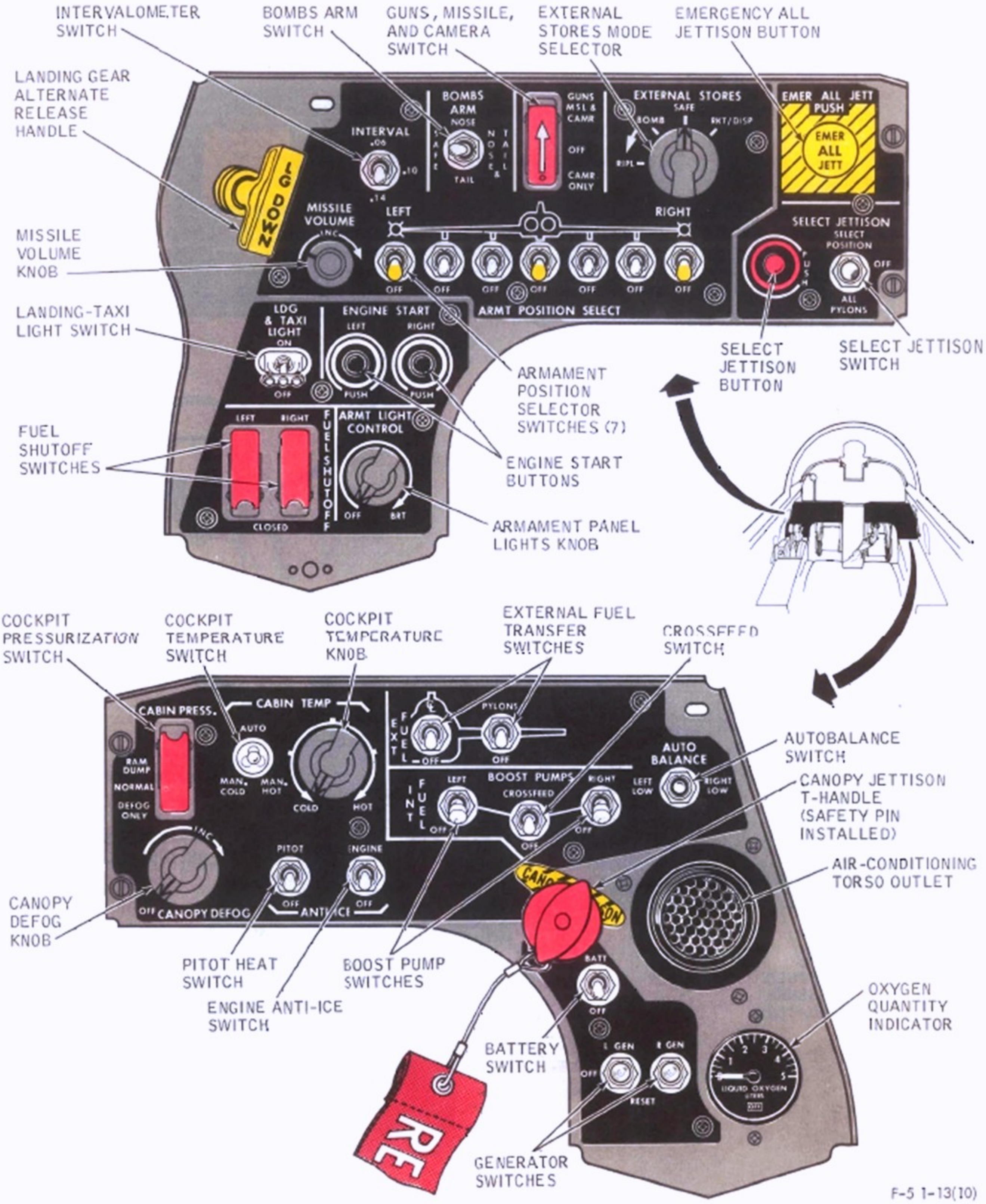


Figure 1-19.

VERTICLE PANELS-REAR

F-1

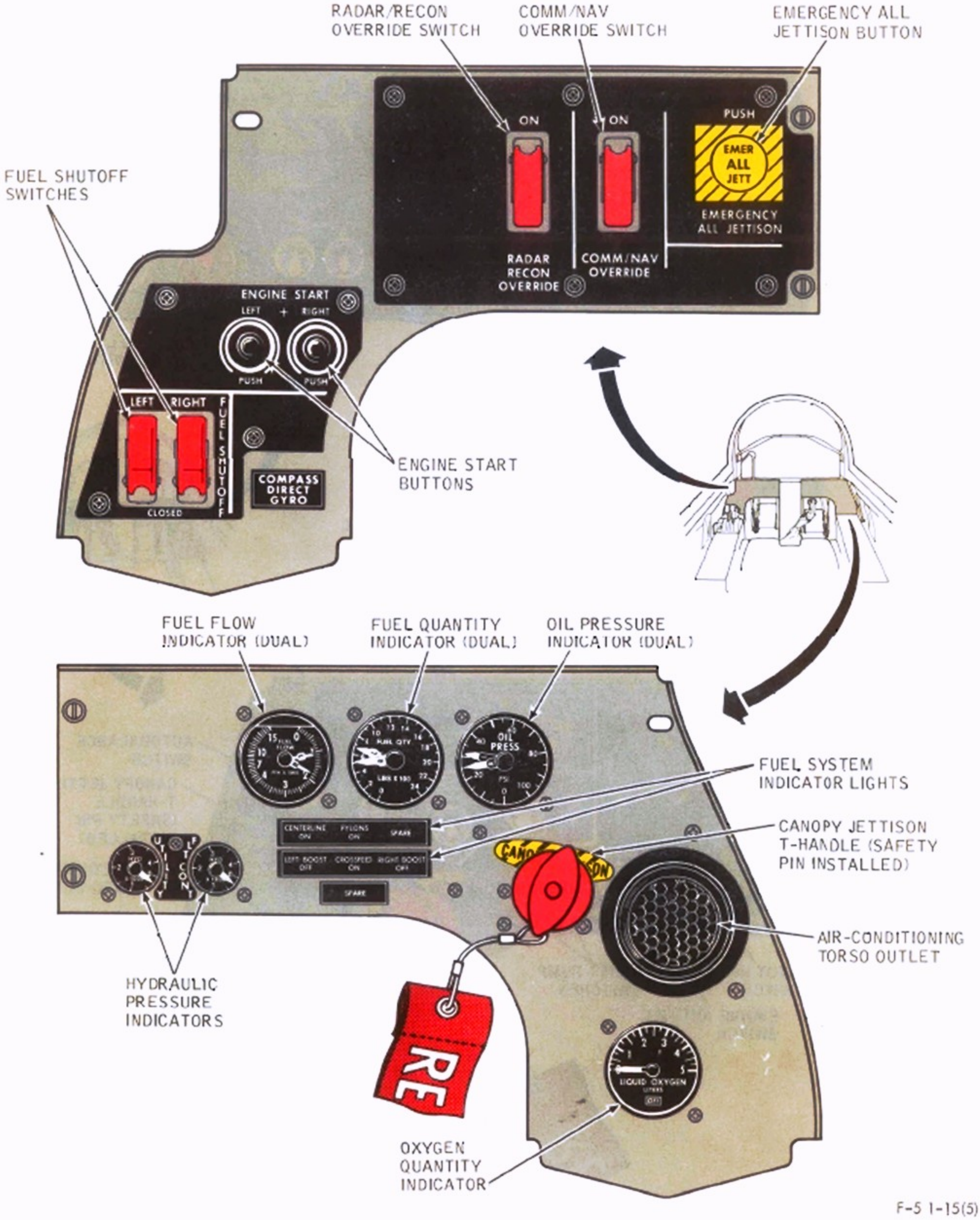


Figure 1-20.

CONSOLE PANELS (TYPICAL)

E EXCEPT E-1

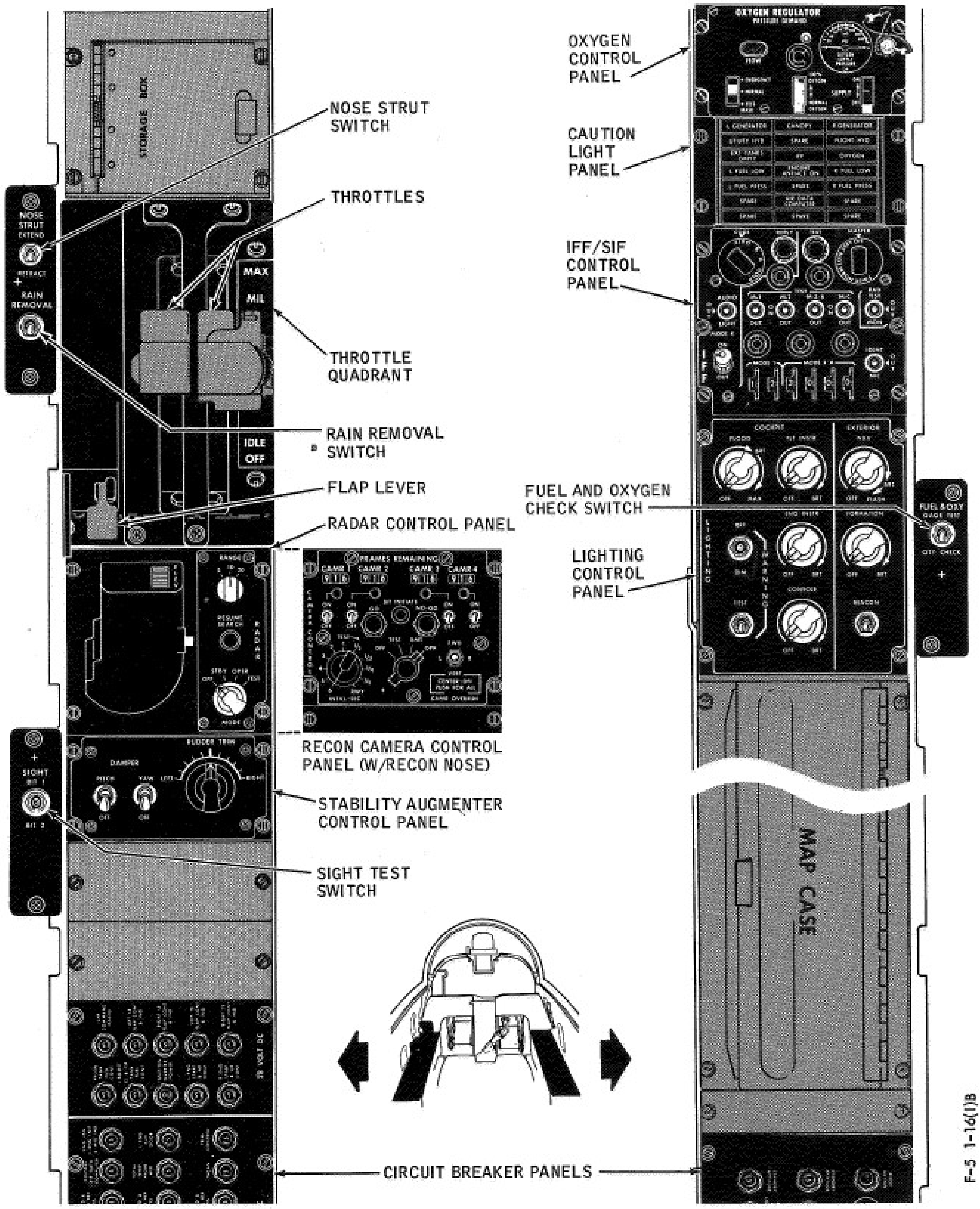


Figure 1-21.

CONSOLE PANELS–FRONT (TYPICAL)

F EXCEPT F-1

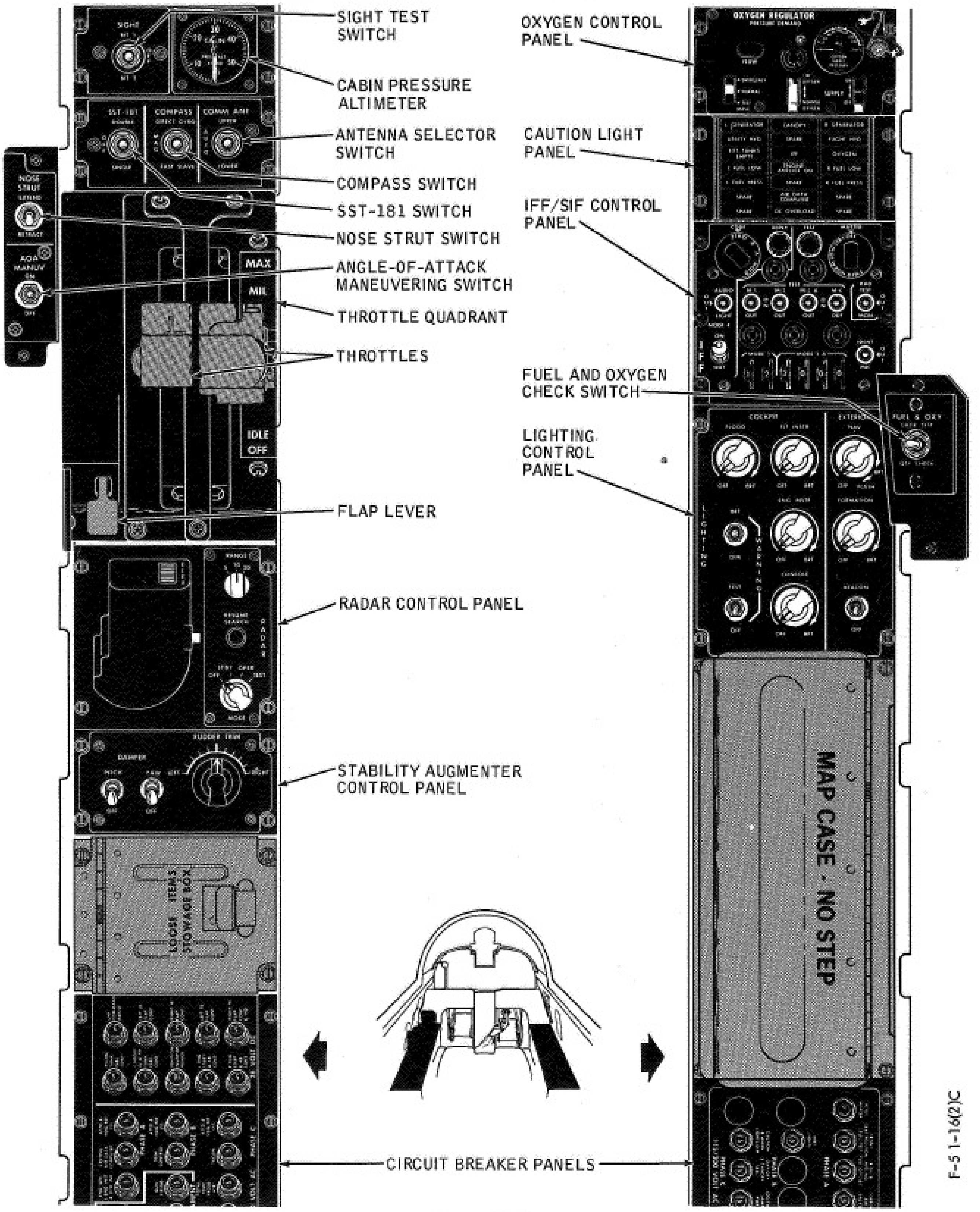


Figure 1-22.

CONSOLE PANELS – REAR

F EXCEPT F-1

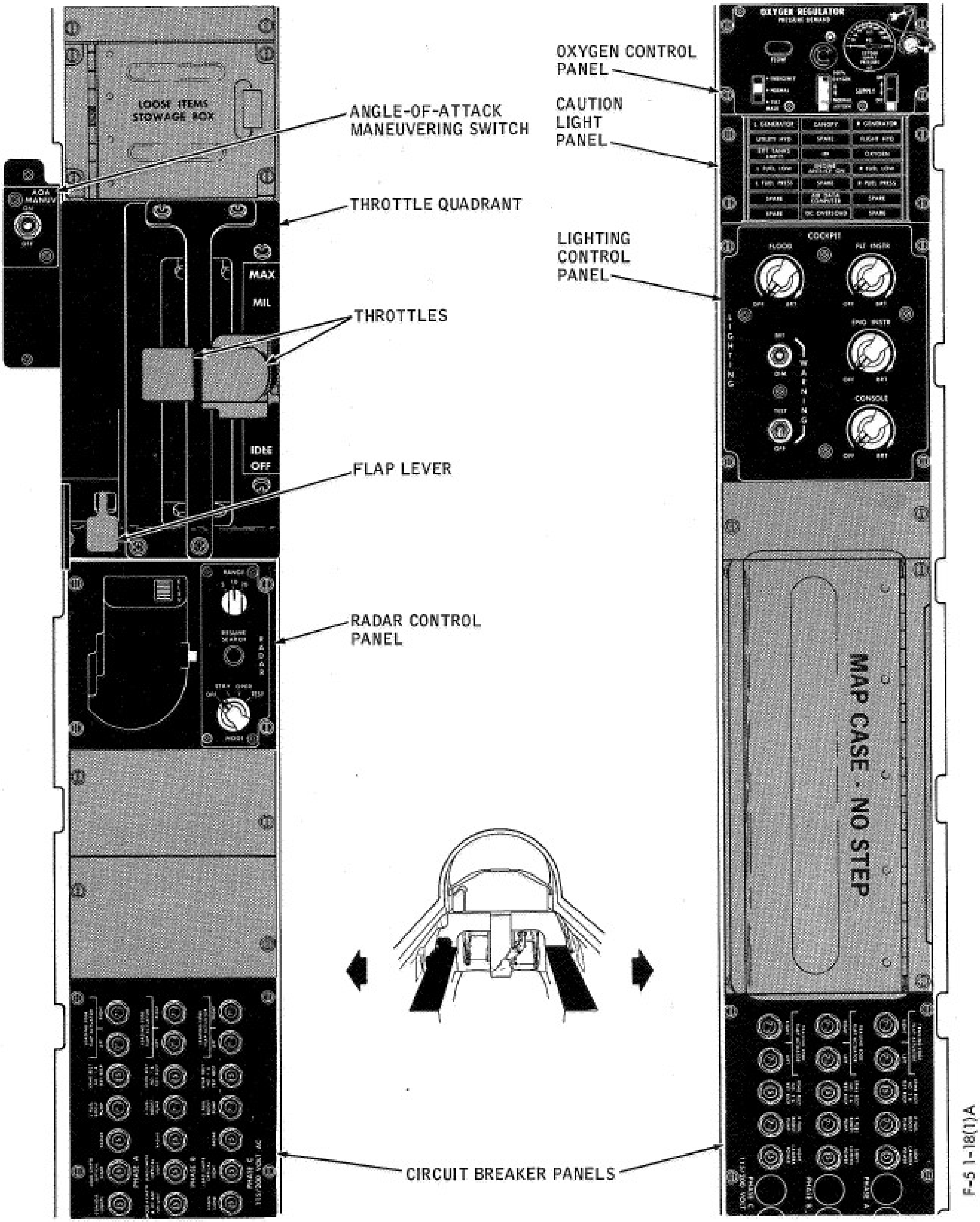


Figure 1-23.

CONSOLE PANELS

E-1

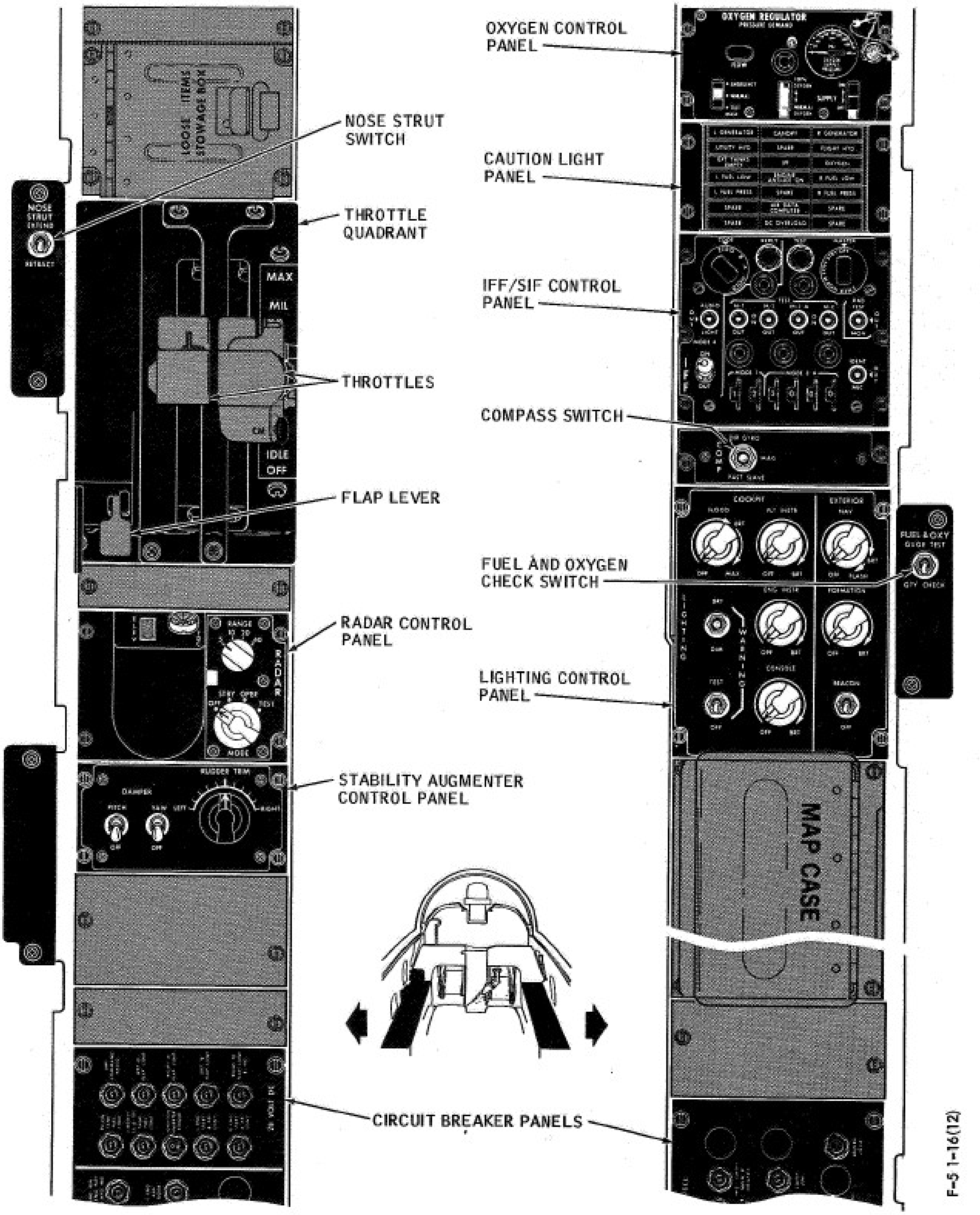


Figure 1-24.

CONSOLE PANELS–FRONT

F-1

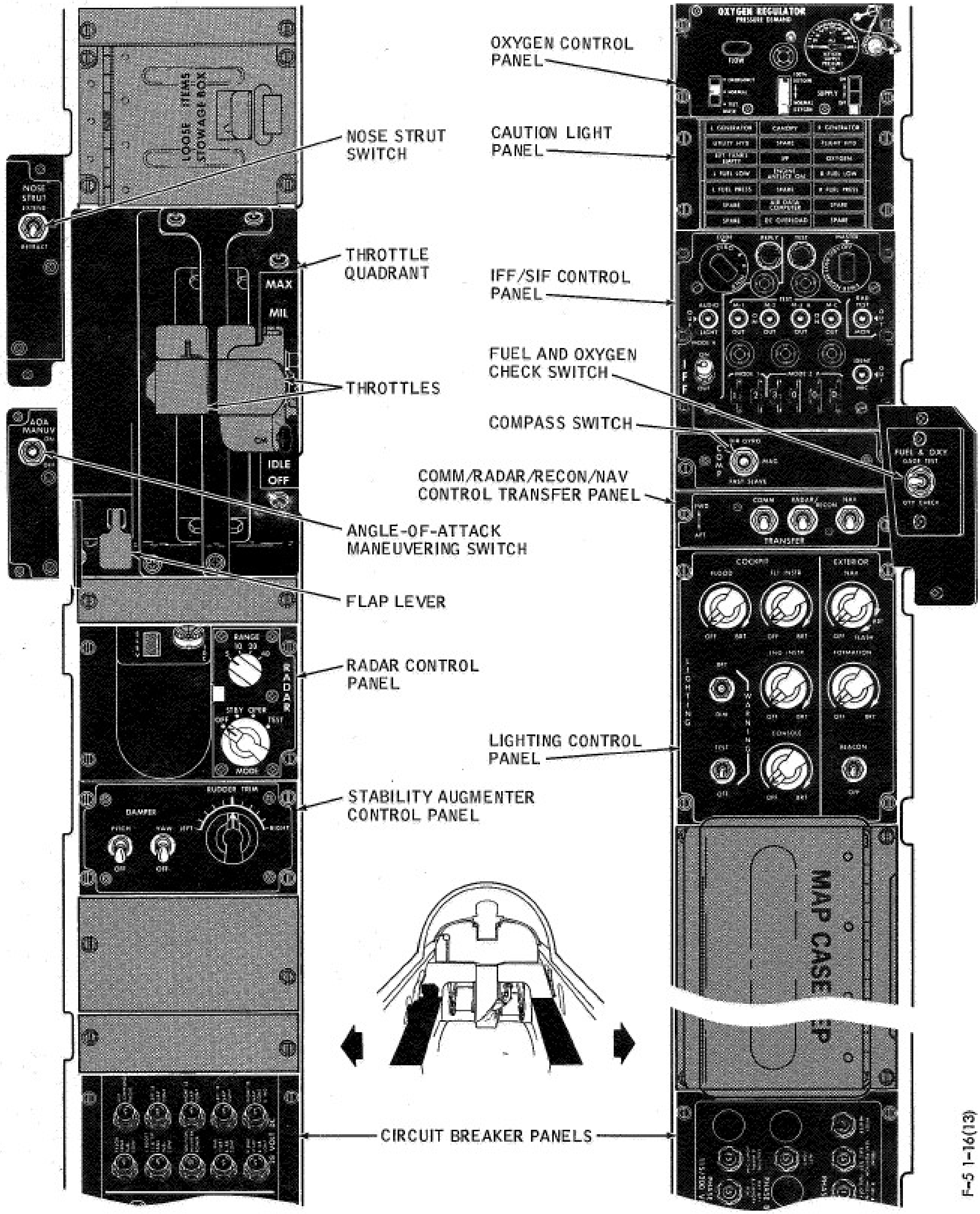


Figure 1-25.

CONSOLE PANELS-REAR

F-1

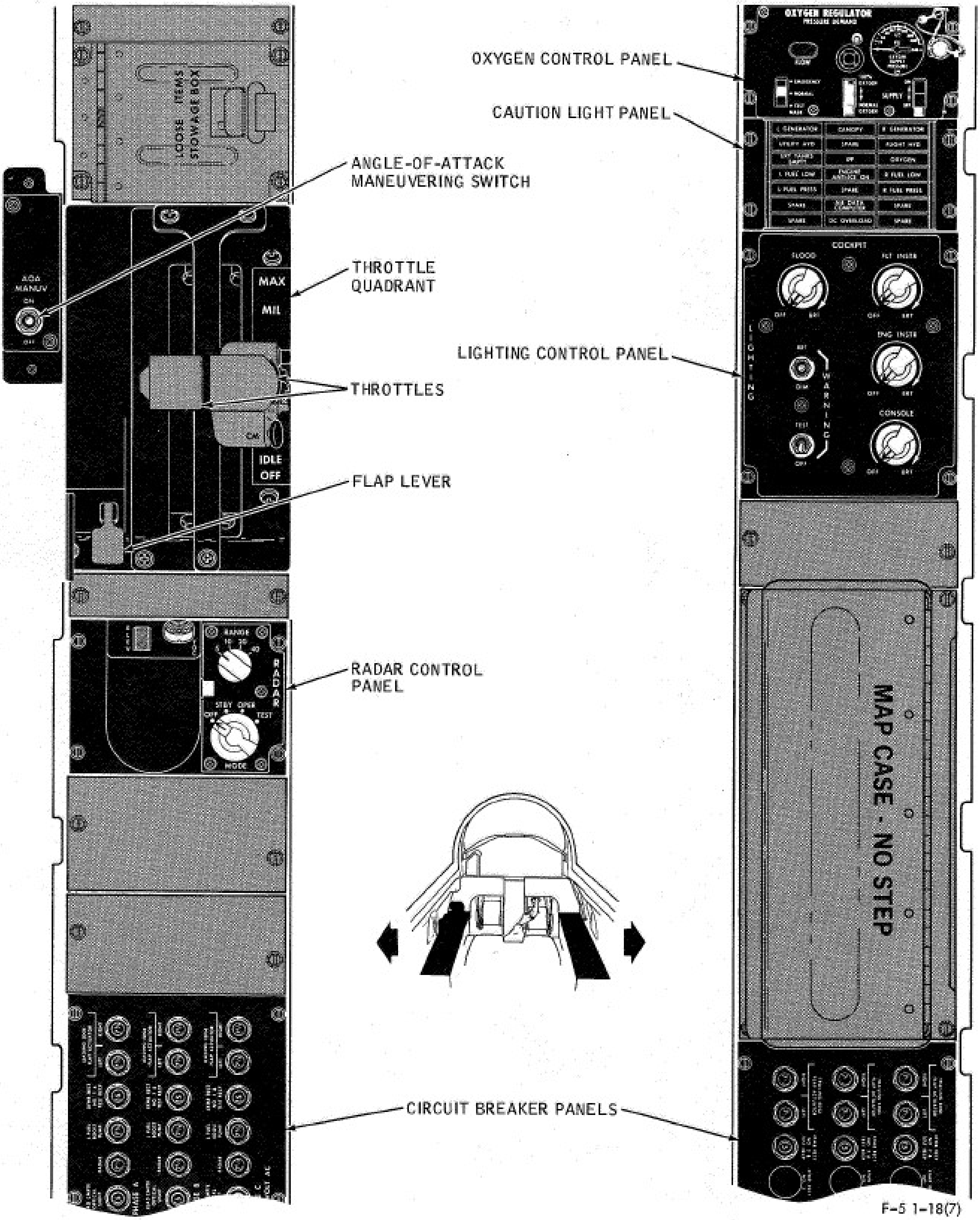


Figure 1-26.

PEDESTAL PANELS (TYPICAL)

E EXCEPT E-1

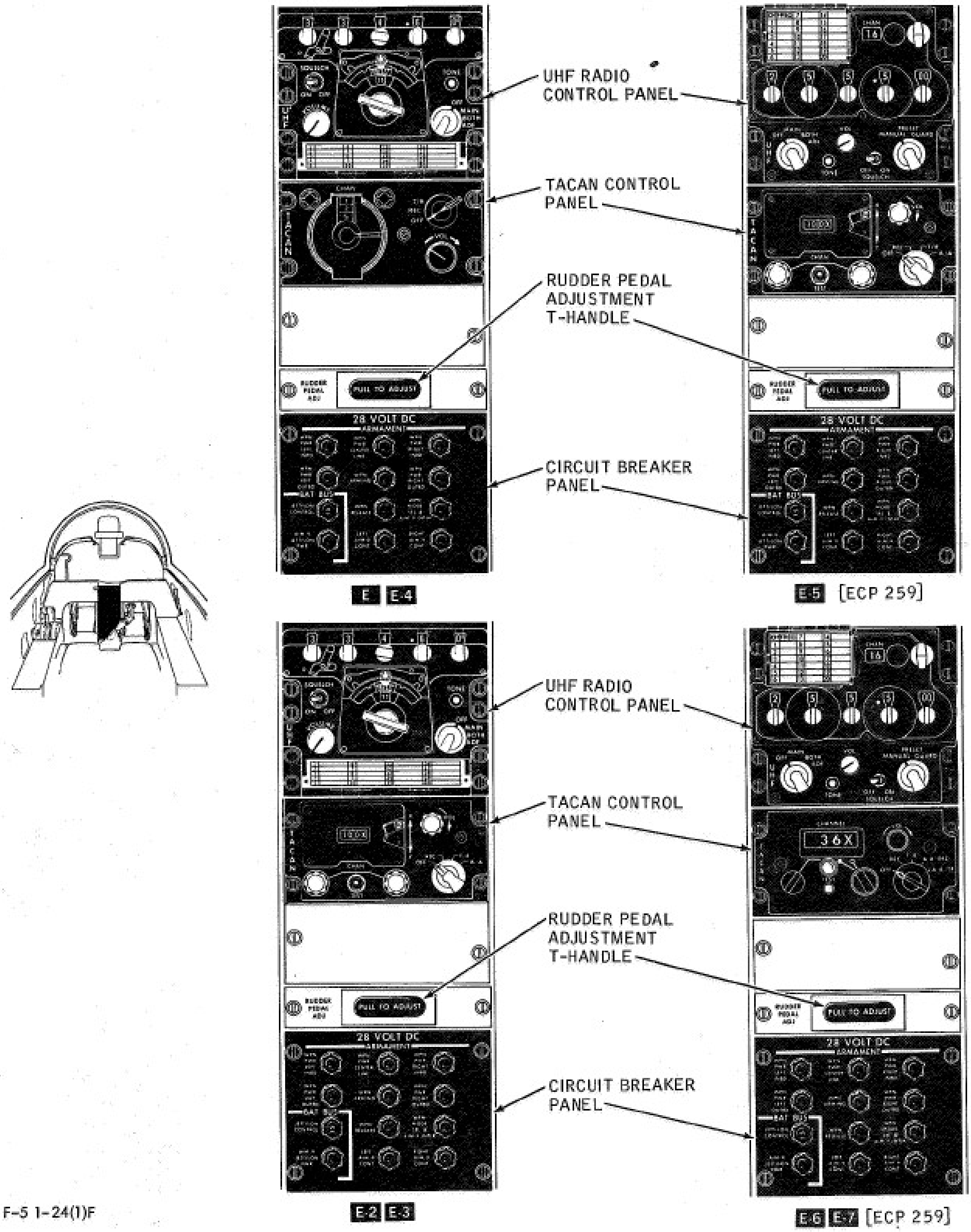


Figure 1-27.

PEDESTAL PANELS – FRONT & REAR (TYPICAL) F EXCEPT F-1

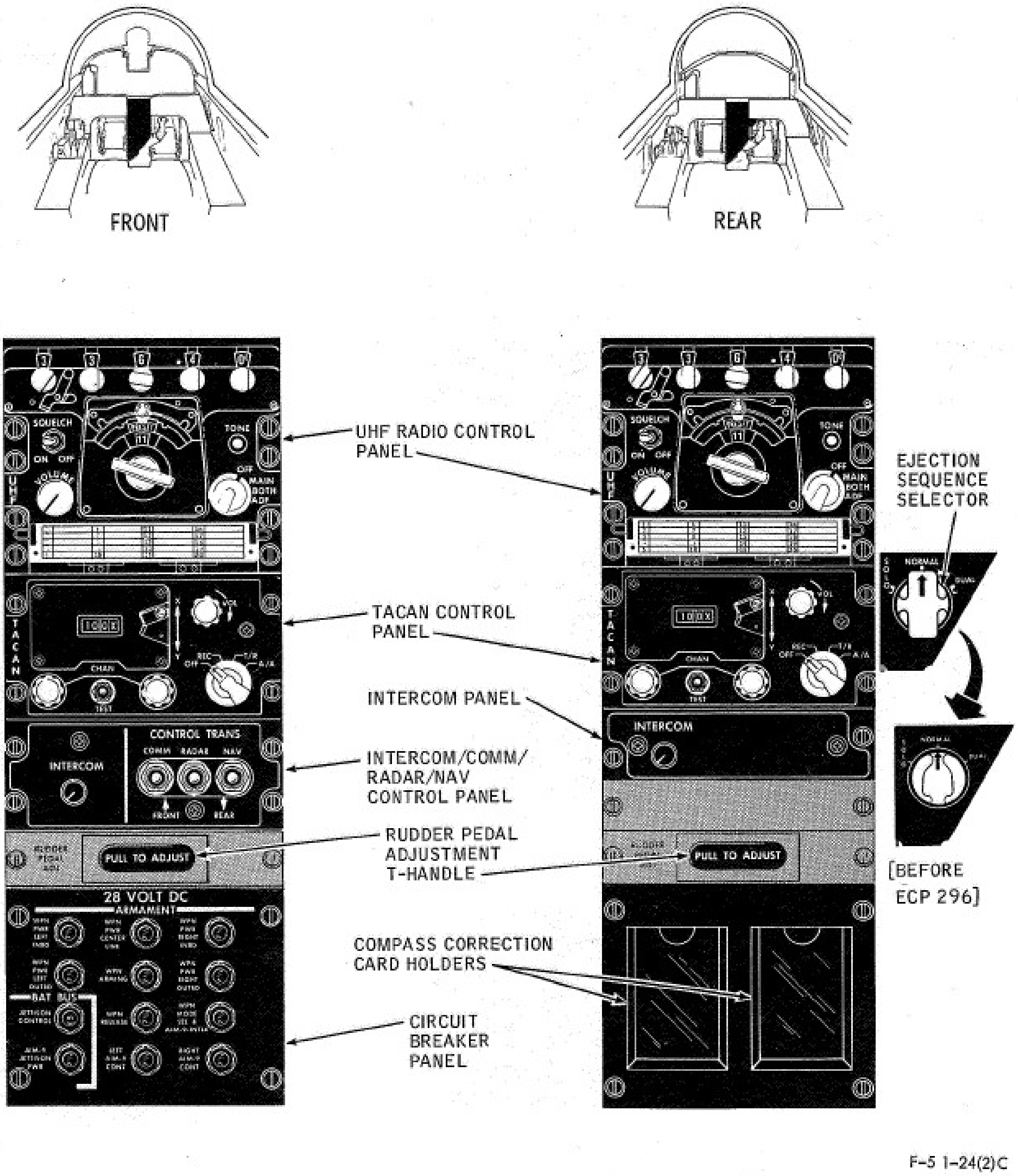


Figure 1-28.

PEDESTAL PANELS

E-1 F-1

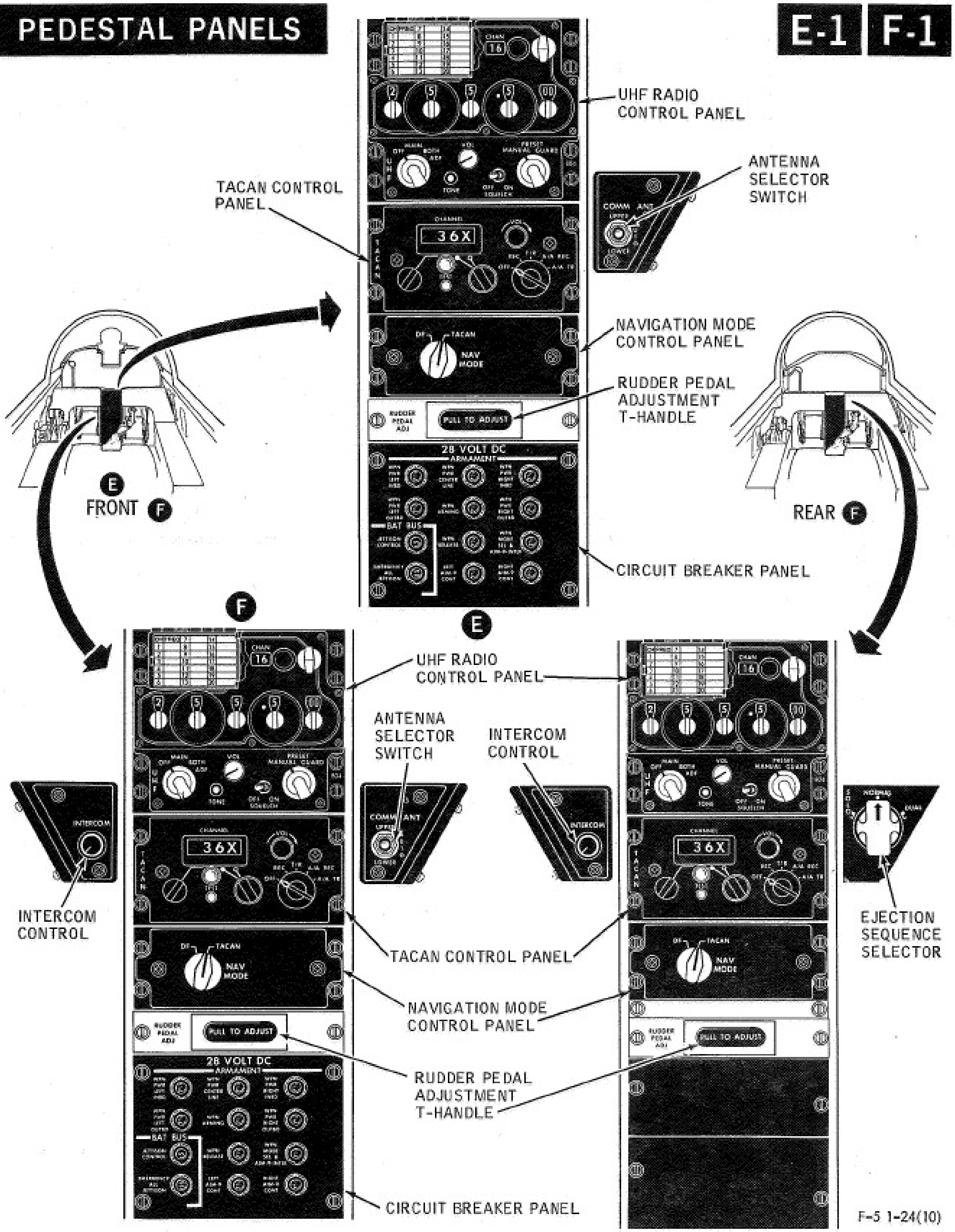


Figure 1-29.

ENGINES

The aircraft is powered by two J85-GE-21 turbojet engines equipped with afterburners (figure 1-30). Sea level, standard day, static thrust at military (MIL) power is 3200 pounds and at maximum afterburner (MAX) power, 4450 pounds. Air to each engine enters thru an air inlet duct on the side of the fuselage and is directed into the engine compressor section by a variable geometry system consisting of inlet guide vanes (IGV) and variable stator vanes. The variable geometry system reduces the possibility of a compressor stall. Compressor bleed air is used to provide anti-icing to the inlet guide vanes, bullet nose, and T_2 sensor of the engine and pressurization to the radar waveguide, windshield and canopy seals, anti-G suit, and external fuel tanks for transferring fuel. Compressor bleed air also provides windshield and canopy defog, cockpit pressurization, and pressurization and cooling of the aft electrical bay and the forward avionics bay. The nine-stage axial flow compressor is coupled directly to a two-stage turbine. Exhaust gases from the combustor section pass thru the two-stage turbine section and are discharged thru a variable exhaust nozzle (VEN). An exhaust gas temperature (EGT) control system electro-hydraulically varies the opening of the VEN to provide overtemperature protection and maintain EGT within allowable limits in MIL and afterburner (AB) power ranges.

AUXILIARY INTAKE DOORS

Auxiliary (aux) intake doors on each side of the fuselage above the wing trailing edge provide additional air to the engines for added thrust during takeoff and low-speed flight. The doors are ac powered and automatically and individually controlled by a true mach signal from the central air data computer (CADC). After takeoff, the doors will close at approximately mach 0.4 (255±10 KIAS). During descent and landing pattern entry, the doors will open at approximately mach 0.375 (235±5 KIAS). An aux intake doors indicator on the instrument panel provides an indication of closed, intermediate, or open position of the doors. During engine start, the auxiliary intake doors will open after each individual generator comes on the line. The normal failure mode of the doors is to the closed position as the doors are spring-loaded closed and actuated open.

J85-GE-21 ENGINE

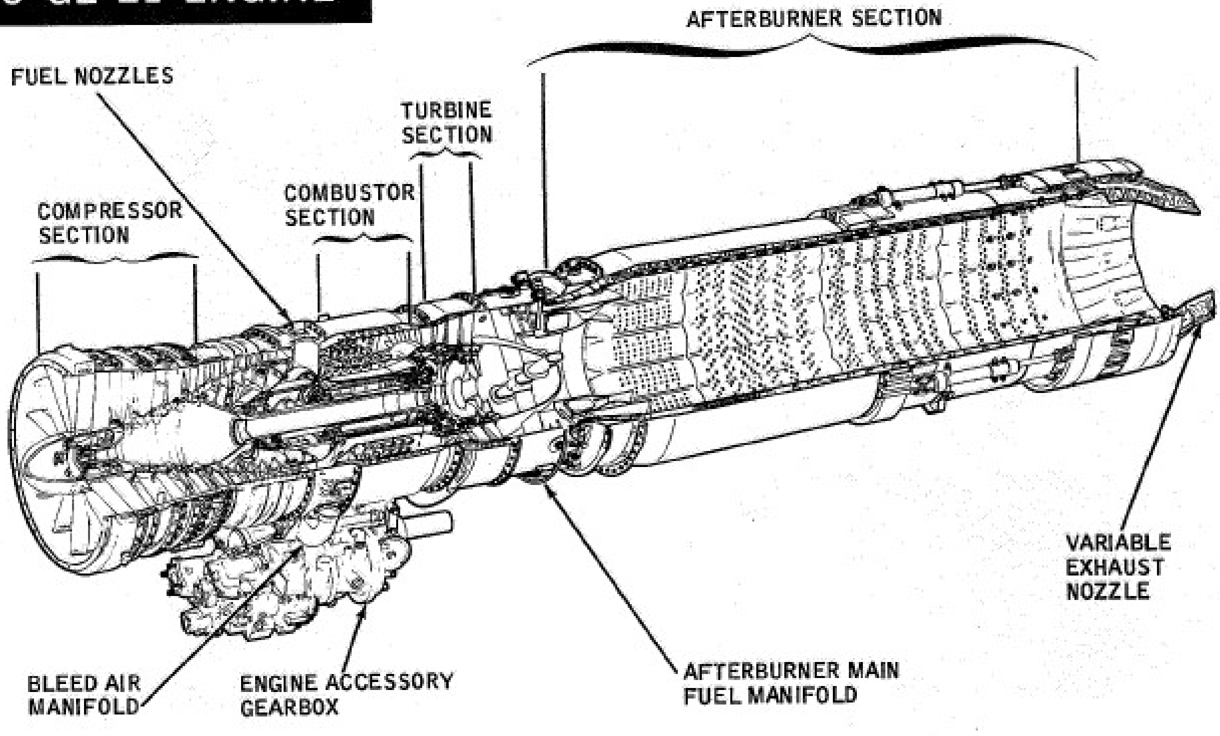


Figure 1-30.

F-5 1-22(1)

CAUTION

- Ground operations—Should a door or both doors fail to open following engine start, reject the aircraft. Should either or both doors fail to open fully during ground operations, the engines are restricted to IDLE or MAX power settings during ground operations to prevent overheating, with occasional transient settings permissible for taxiing. (See section V for limitations.)
- Takeoff— If the doors fail in the CLOSE position during takeoff roll, a thrust loss of approximately 7 percent and a corresponding increase in takeoff ground roll should be expected. (See appendix I for performance.)
- In Flight — Doors failed in the OPEN position. An increase in fuel consumption of up to 10 percent, depending on flight conditions, may occur, and flight planning should be adjusted accordingly.
- In Flight — Doors failed in the CLOSE position. Since this failure is most probable at low altitudes and airspeeds, the most probable effect is upon landing pattern entry and the subsequent pattern, approach, and landing. With this condition, the approximate thrust loss of 7 percent should be kept in mind for possible go-around or missed approach power requirements.
- In Flight — Doors failed in an intermediate position. With this condition, assume the "worst case" of the in-flight failures discussed above and proceed accordingly and as mission requirements dictate.

Normal airstarts can be made with doors failed in the open or intermediate position.

THROTTLES

The throttle (figure 1-31) for each engine provides main engine control from OFF to IDLE, IDLE to MIL and afterburner (MAX) control from minimum to maximum afterburner operation. Each throttle controls respective engine fuel supply, firewall shutoff valve, main fuel control throttle angle and stopcock valve, main and afterburner ignition circuitry, engine speed, and afterburner control operation. The left throttle also controls crossbleed start valve circuitry. Fingerlifts on the forward side of each throttle (Ⓕ front cockpit only)

THROTTLE QUADRANT (TYPICAL)

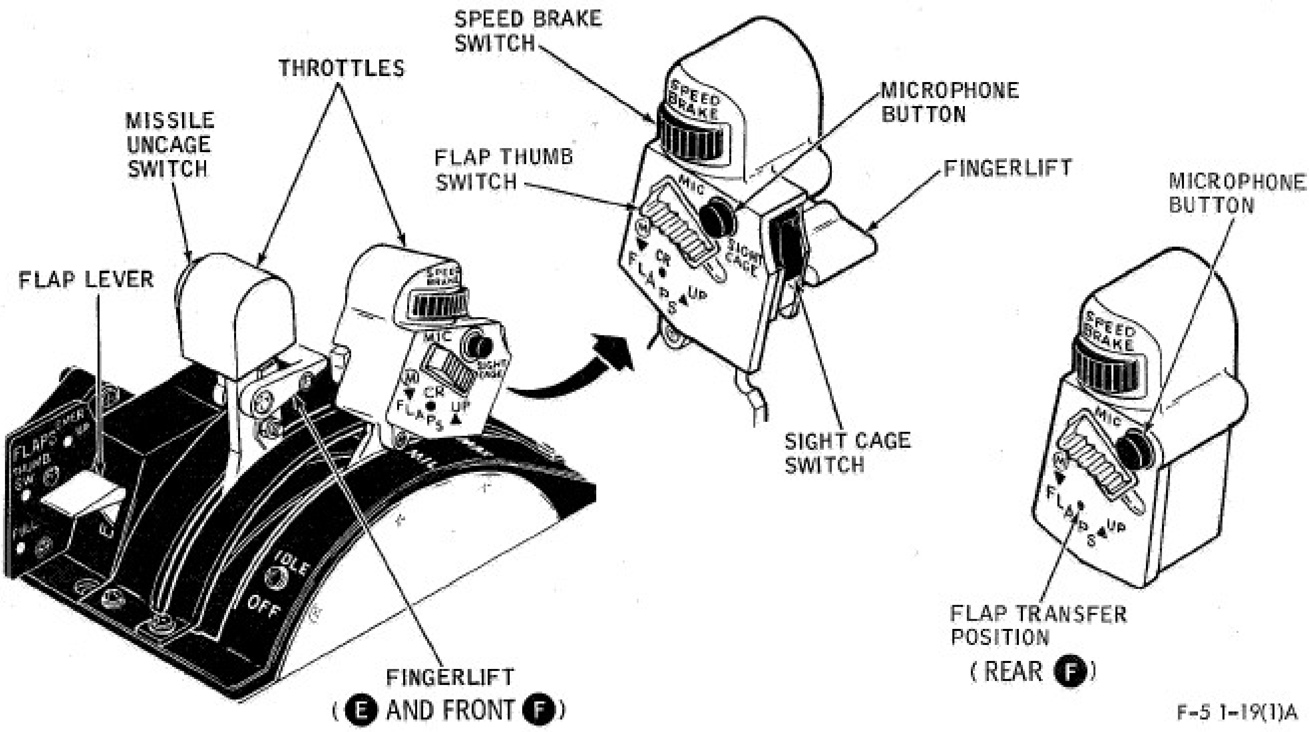


Figure 1-31.

provide a stop detent at IDLE. Raising the fingerlift permits retarding the throttle from IDLE to OFF. In the IDLE to MIL range, throttle friction is constant. A spring detent between MIL and MIN afterburner must be passed over for afterburner or nonafterburner operation. Afterburner thrust modulation is provided throughout the afterburner range. Throttle friction in the afterburner range is slightly greater than that provided from IDLE to MIL position. Throttle friction is preset and not adjustable by the pilot.

IGNITION SYSTEM

The ignition system provides electrical ac power for starting either engine on the ground or during flight. The ignition system for each engine consists of an engine start button, arming circuits, 40-second ignition timer, and main and afterburner igniters. AC power can be provided by an external electrical power unit, aircraft generator power, or aircraft battery powered static-inverter. Engine start buttons are provided in both Ⓕ cockpits. With the battery switch OFF, the engine start button ignition circuits are inoperative. With the battery switch at BATT and the throttle at OFF, pushing the engine start button arms the ignition circuit and starts the ignition timer. The ignition circuit is completed to the main and afterburner igniters when the throttle is positioned at IDLE. When the throttle is advanced from MIL into AB range, (with or without external power) the ignition circuit is completed to the main and afterburner igniters, starting the ignition timer for approximately 40 seconds. Afterburner ignition and timer operation may be discontinued at any time by retarding the throttle out of AB range. For ground starts only, the ignition duty cycle is 2 minutes on, 3 minutes off, 2 minutes on, 22 minutes off. See figure 1-32 for location and function of engine controls and indicators.

ENGINE FUEL CONTROL SYSTEM

The engine fuel control system (figure 1-33) meters the proper amount of fuel to the engine for optimum performance throughout the engine operating range.

Main Fuel Pump

The engine-driven main fuel pump is a combination boost and high-pressure pump mounted on the engine accessory gearbox. The main fuel pump also provides servo fuel pressure to the afterburner control servos and the afterburner shutoff valve.

Main Fuel Control

A hydromechanical main fuel control, consisting of a metering section and a computing section, regulates the fuel flow to the engine and schedules the variable geometry system to maintain operation within limits. Pressurized fuel from the engine-driven fuel pump flows thru the main fuel control to the overspeed governor, the oil coolers, pressurizing and drain valve, and is distributed by the main fuel manifold to the 12 main fuel nozzles.

Overspeed Governor

The hydromechanical overspeed governor is provided to limit engine speed to a maximum steady state of about 106% rpm if the main fuel control should fail.

VARIABLE EXHAUST NOZZLE (VEN) OPERATION

VEN operation is controlled by throttle position and egt. When the throttle is advanced slowly to MIL, nozzle opening decreases toward 0% until approximately 85% rpm. At this point, the nozzle remains constant at a fixed cruise flat position (16% to 22%) until the throttle is advanced to where the nozzle starts to further close toward 0%. The engine delivers best cruise power performance with minimum fuel consumption when on the cruise flat. When the throttle is advanced beyond the cruise flat toward MIL rpm, the nozzle will continue to close until an egt above 670° ±5° is momentarily reached. The nozzle will then open via the T_5 amplifier control to maintain egt within limits. This is called T_5 modulation. Just prior to T_5 modulation, the nozzle is still mechanically controlled by the throttle. A throttle setting just prior to T_5 modulation will improve fuel consumption rates during MIL power climbs. When T_5 modulation occurs, the nozzle will open slightly. During a rapid throttle burst from IDLE to MIL or MAX, the nozzle will close to 43% to 53%, and stay at that opening momentarily. Nozzle hesitation at this point during acceleration minimizes exhaust back pressure to provide rapid acceleration and to preclude compressor stall. The nozzle will then close to 0% to 3% until T_5 modulation occurs. At high altitude, low airspeed, when a throttle burst from IDLE or cruise to MIL or MAX is made, the nozzle will open toward the 43% to 53% area, then close to approximately 7% to 12% to minimize rpm rollback and compressor stall prior to T_5 modulation. During a throttle burst to AB range at low altitude, the main afterburner fuel flow is delayed by a sequence valve,

ENGINE CONTROLS/INDICATORS (TYPICAL)

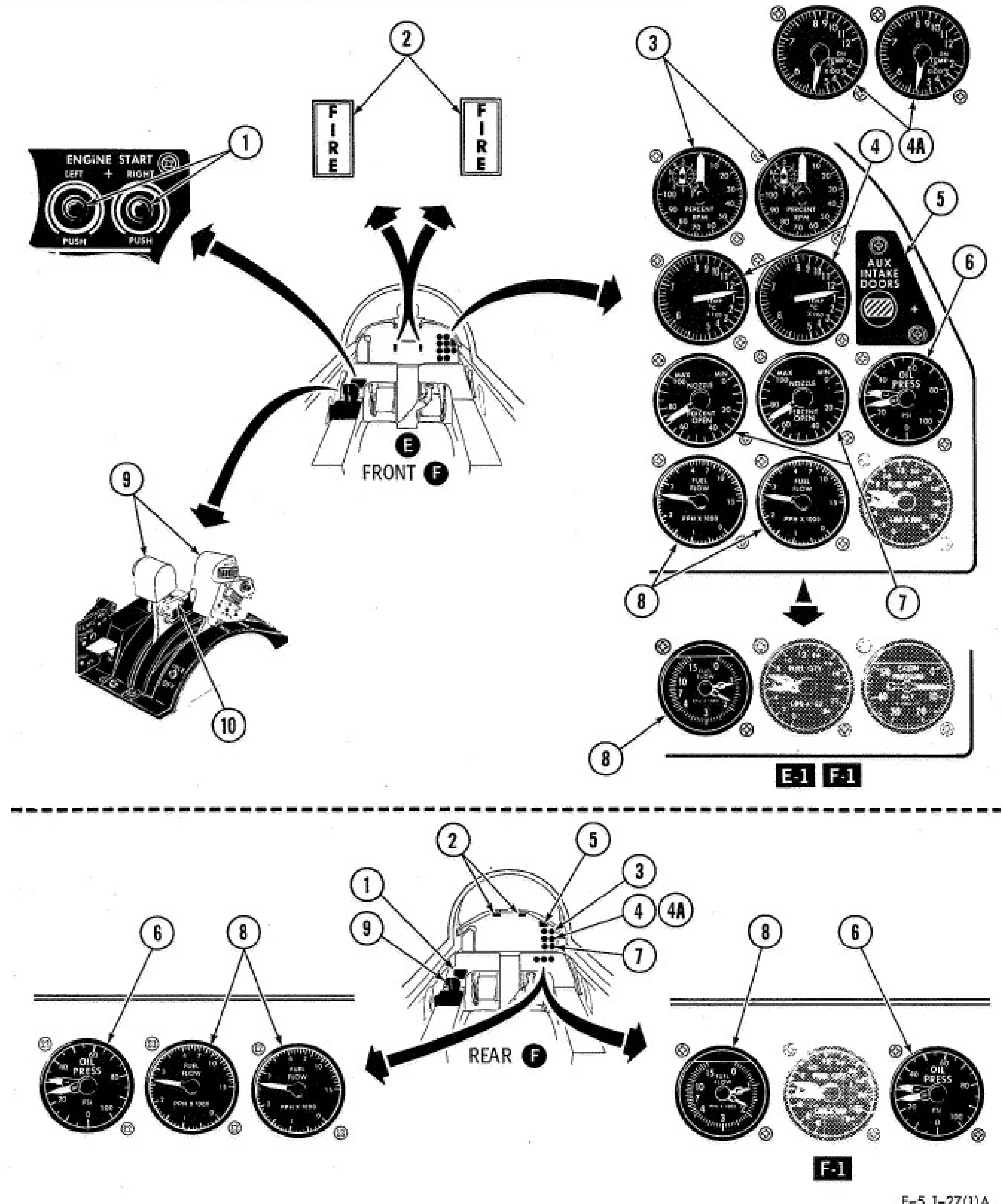


Figure 1-32.

ENGINE CONTROLS/INDICATORS (Figure 1-32)

CONTROLS/INDICATORS	FUNCTION
1 ENGINE START Buttons (LEFT and RIGHT)	Push —Momentarily pushing button for selected engine electrically arms ignition circuit and allows ignition timer to run for approximately 40 seconds.
2 FIRE Warning Lights (RED) (L&R)	On —(FIRE) Indicates a fire or overheat condition in respective engine compartment. Light will remain on until condition is corrected and then go out. If condition recurs, light will come on.
3 Engine Tachometers (L&R)	Indicates engine rpm in percent from 0 to 110%
4 Exhaust Gas Temperature (EGT) Indicators (L&R) (EHU-31/A)	Indicates biased engine EGT in °C.
4A Exhaust Gas Temperature (EGT) Indicators (L&R) (EHU-31A/A)	Indicates biased engine EGT in °C. **WARNING** With these indicators, it is possible to experience an engine start or flameout unrecognized by the pilot because the instrument does not indicate below 200°C.
5 AUX INTAKE DOORS Indicator	CLOSE — Indicates both intake doors fully closed. OPEN — Indicates both intake doors fully open. Barber Pole — a. Indicates one or both intake doors are at intermediate position. b. Indicates one intake door open, the other intake door closed. c. Indicates dc power is not available.
6 Oil Pressure Indicator-Dual (L&R Pointers)	Indicates engine oil system pressure in psi.
7 Nozzle Position Indicators(L&R)	Indicates nozzle position in percent of fully open position.
8 FUEL FLOW Indicators (L&R) ([E-1] [F-1] Dual - L&R Pointers)	Indicates total fuel flow (including afterburner) in PPH to each engine.
9 Throttles (L&R)	OFF — Deactivates engine ignition and cuts off fuel flow to engine. IDLE — a. During start, completes engine ignition circuit and opens main fuel shutoff valve. b. Operates engine at IDLE power. MIL — Operates engine at MIL power. MAX — Going from MIL to MAX activates main and afterburner ignition circuit for approximately 40 seconds and opens AB pump shutoff valve for MAX power operation.
10 Fingerlifts (L&R Throttles) (Ⓕ Front Cockpit Only)	Down — Prevents movement of throttles from IDLE to OFF position. Raised — Permits movement of throttles from IDLE to OFF position, closing main fuel shutoff valves.

ENGINE FUEL CONTROL SYSTEM (TYPICAL)

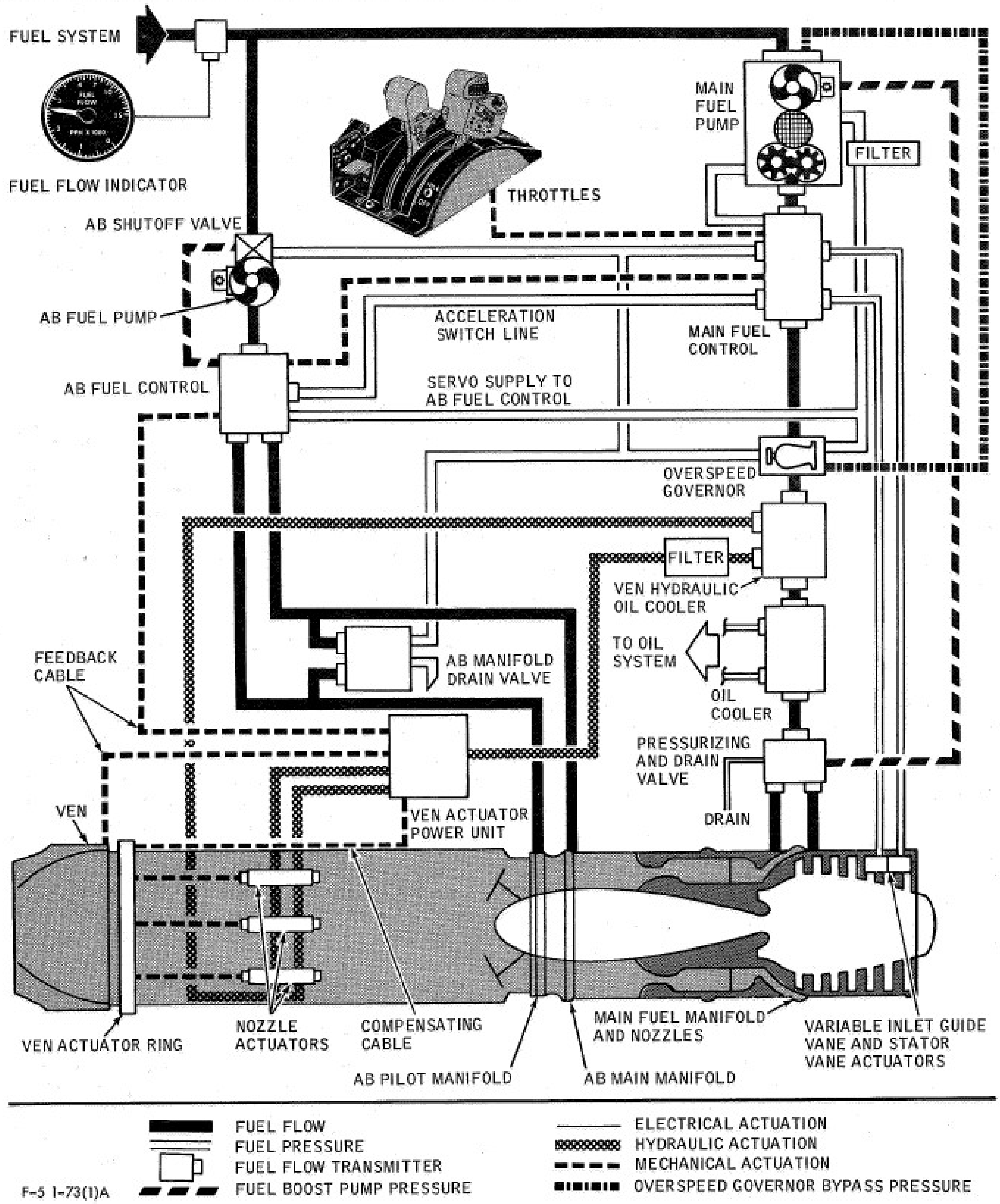


Figure 1-33.

momentarily causing the nozzle to pause (approximately 6% to 14% above MIL steady-state nozzle position) to allow afterburner pilot fuel to light off first; permitting a softer afterburner lightoff, thus reducing rpm rollback and compressor stall. In the event of engine overtemperature during nozzle modulation, the nozzle will open to approximately 28% to 38% to maintain safe egt operation. This nozzle position is known as the T_5 lockout area. At high altitudes and low airspeeds, MIL nozzle opening may be larger and egt lower than observed at low altitudes and high airspeeds. During ground operation at MIL power, nozzle opening should be approximately 10%. As the throttle advances into the AB range, opening should approximate 25% to 50% in minimum afterburner, increasing to approximately 80% at maximum afterburner. Nozzle indication of 75% or higher indicates a full-open nozzle (nozzle-limited) condition. Under this condition, fuel flow to the affected engine will be reduced to maintain EGT within limits. If the T_5 amplifier fails during MIL or AB power, retard the throttle to maintain egt within limits if flight conditions permit.

T_5 AMPLIFIER SYSTEM

The T_5 amplifier system maintains a preset turbine discharge egt within allowable limits during MIL and AB power operation by varying the exhaust nozzle opening. Operation is automatic with ac power supplied by the engine tachometer generator. If EGT is higher than the reference temperature, the amplifier causes the VEN to open; if lower, the VEN will close. The system operates primarily in MIL and AB power ranges.

Engine Inlet Temperature

The T_2 sensor and the T_2 resistance-temperature-detector (RTD) are two engine components that indirectly control MIL/AB rpm and egt. The T_2 sensor in the main fuel control repositions the three-dimensional cam to schedule rpm, variable geometry system, and set the proper acceleration fuel flow schedule during throttle transients throughout the operational envelope. T_2 temperature controls MIL/AB rpm. For example, as airspeed increases, T_2 temperature increases and MIL/AB rpm will increase. When T_2 temperature decreases, as in a sustained climb, MIL/AB rpm will also decrease. With T_2 temperature of –43°C and below, MIL/AB rpm may be as low as 90%. The T_2 RTD biases the T_5 amplifier at cold engine inlet temperatures to cut back fuel flow and corresponding egt to prevent compressor and turbine stresses.

AFTERBURNER SYSTEM

Afterburner operation is initiated by advancing the throttle from MIL to AB range. Afterburner lightoff on ground should occur within approximately 5 seconds.

Afterburner Fuel Pump and Shutoff Valve

The engine-driven afterburner fuel pump is a single-stage centrifugal pump. The pump supplies fuel to the afterburner fuel control during afterburner operation. The afterburner shutoff valve, actuated by fuel pressure from the main fuel control, prevents fuel supply to the afterburner fuel pump inlet until the throttle is positioned in the afterburner range and the engine is operating at nearly military rpm.

Afterburner Fuel Control

The hydromechanical afterburner fuel control contains a fuel metering section, a computing section, and a variable exhaust nozzle (VEN) control section. Fuel is scheduled to the afterburner main manifold spraybars as a function of throttle position, compressor discharge pressure, and nozzle position, and to the pilot manifold spraybars as a function of compressor discharge pressure only.

ENGINE OIL SYSTEM

Each engine has an independent, self-contained oil supply and lubrication system with a serviceable capacity of 4 quarts. The system consists of an oil reservoir, a lubricating and scavenging six-element pump, oil filter and bypass, and an oil cooler (oil-to-fuel heat exchanger) with a pressure-controlled bypass valve. Oil is pumped from the reservoir and delivered under pressure thru the oil cooler and the oil filter to the engine accessory drive gearbox, main bearings, and other internal moving parts. Oil is returned to the reservoir thru the scavenging system. A sump vent system maintains a positive pressure, making the lubrication system insensitive to altitude. Large oil pressure fluctuations and zero oil pressure may occur during maneuvering flight. (See section V, Operating Limitations.)

FIRE WARNING AND DETECTION SYSTEM

The fire warning and detection system provides a visual indication of a fire or an overheat condition in the engine compartment. When the system detects a fire or overheat condition, the fire warning light for the respective engine will come on.

AIRFRAME-MOUNTED GEARBOX

An airframe-mounted gearbox is located forward and below each engine. Each engine-driven gearbox operates a hydraulic pump and an ac generator. Automatic gearbox shift occurs in the 68%-72% engine rpm range.

ENGINE OPERATION

Ground Start

Starting the left engine requires an external low-pressure air source for initial motoring of the engine. After starting the first engine, the other engine is started by using the same external air source directed by a manually operated diverter valve. With external ac power applied, battery switch in BATT position, and the engine motoring at 10% rpm or above, momentarily pushing the start button arms the ac-powered ignition circuit and permits the ignition timer to run for approximately 40 seconds. The ignition circuit to the main and afterburner igniters is completed and fuel flow starts to the engine when the throttle is advanced to IDLE. Without external ac power and the battery switch at BATT, a battery-powered static inverter will activate to provide ac power for engine start when the start button is pushed. After one engine has been started and the generator is on the line, the static inverter is automatically disconnected.

Crossbleed Start

A crossbleed start capability without external air is provided for starting the right engine after the left engine has been started. Compressed air from the ninth stage of the left engine compressor section is used for initial motoring of the right engine. A crossbleed control valve installed as part of the left engine compressor ducting system is alerted for activation when the left engine throttle is advanced above 70% rpm. Actuation of the right engine start button will then open the crossbleed control valve, permitting air to flow from the left to the right engine. The right engine ignition circuit is then completed by moving the right throttle from OFF to IDLE position. In order to ensure an adequate flow of air for starting, the left engine should be operating at approximately 95% rpm. The crossbleed control valve closes and power is removed from the valve-open circuit any time the left throttle is below approximately 70% rpm, the aircraft is airborne, or approximately 40 seconds after the right engine start button has been actuated.

Airstart

If the throttle is at OFF, the airstart is accomplished by pushing the engine start button and advancing the throttle to IDLE, the same as for ground starts. If the throttle is in the IDLE to MIL range, alternate airstart is accomplished by advancing the throttle into AB range, which activates the engine ignition circuits to the main and afterburner igniters and allows the timer to run for approximately 40 seconds. If the throttle is in AB range, the throttle must be cycled to MIL and returned to AB range to activate the ignition circuits and timer; or a start may be obtained with throttle in AB range by pushing and holding engine start button until lightoff occurs. The battery switch must be at BATT to activate the static inverter when the engine start button is pushed to complete engine start. With no ac power, the battery switch must be at BATT to provide ignition when throttle is moved into AB range.

COMPRESSOR STALL

A compressor stall is an aerodynamic interruption of airflow thru the compressor. The stall sensitivity of an engine is increased by foreign object damage, high angles of attack at low airspeeds and high altitudes, abrupt yaw impulses at low airspeeds (below approximately 150 KIAS), temperature distortion, engine anti-ice system in operation, and ice formation on the engine inlet ducts or inlet guide vanes. (See discussion in section VII, Adverse Weather Procedures.) Compressor stalls can also be caused by component malfunctions; engine rigged out of limits; throttle bursts to MIL or MAX power at high altitude and low airspeed; hot gas ingestion from other aircraft or during gun firing at high altitudes and negative g conditions; and maneuvering flight with landing gear down at altitudes above 30,000 feet. Variable inlet guide vanes and variable stators have been installed in the engine to reduce the possibility of compressor stall. Operation is automatic as a function of engine rpm and inlet temperature. A P_3 compressor dump system [T.O. 1F-5-740] activates for approximately 16 seconds to reduce the possibility of compressor stall when a throttle is burst to AB range at intermediate or high altitudes; however, installed engines must also be modified with a connecting P_3 dump system. During sustained maneuvering without throttle movement, increased stall margin can be obtained by positioning the throttle at 85% to 95% rpm.

NOTE

Engines without P3 dump system may be installed in aircraft modified by T.O. 1F-5-740, or engines with P3 dump system may be installed in unmodified aircraft. In either case, the P3 dump system will be inoperable.

FLAMEOUT

Flameout may be caused by component malfunctions, compressor stall, fuel starvation, fuel contamination (water), fuel icing, engine inlet guide vane icing and by throttle transients outside the normal flight envelope. (See related discussion in section VII, Adverse Weather Procedures.) Improper recovery from an unusual attitude such as a high pitch attitude stall (see section VI) can produce an abrupt yaw at low airspeed, causing compressor stall and flameout.

FUEL SYSTEM

The fuel system (figure 1-34) consists of three bladder-type fuel cells in the fuselage divided into two independent systems. Each cell contains a network of explosion and fire suppressant foam material. The forward cell supplies fuel to the left engine; the center and aft cells supply the right engine. Either system can supply fuel to both engines. Additional fuel may be carried in jettisonable external tanks. Fuel is transferred from external tanks to the internal systems thru the single-point manifold by air pressure supplied by the compressor ninth stage of each engine. Each internal system contains an individually controlled fuel boost pump, a fuel shutoff valve controlled by either the throttle or a shutoff switch, a fuel flow indicator, and fuel low and pressure caution lights. A dual-pointer fuel quantity indicator serves both internal systems. Fuel quantity and fuel flow indications are provided in both Ⓕ cockpits. The internal system contains a 2-way semiautomatic fuel crossfeed balancing system controlled by the autobalance switch. A crossfeed switch and left and right fuel boost pump switches (Ⓕ front cockpit only) are provided to manually control crossfeed operation. The internal system contains a common vent to vent fuel vapors overboard at the vertical stabilizer trailing edge just above the rudder. Control of external fuel transfer to internal system is provided by external fuel transfer switches (Ⓕ front cockpit only). An external tanks empty caution light (Ⓕ both cockpits) indicates that selected external tanks are empty.

FUEL SYSTEM INDICATOR LIGHTS Ⓕ

Rear cockpit fuel indicator lights provide indication of external fuel, boost pump, and crossfeed switch positioning. With fuel system in autobalance operation, the indicator lights will indicate left or right boost pump off and crossfeed on.

FUEL BOOST PUMPS

Two ac-powered dual-inlet fuel boost pumps provide fuel under pressure to the engine-driven main fuel pump, and during afterburner operation, to the engine-driven afterburner fuel pump. The left system boost pump is in the inverted flight compartment of the forward fuel cell; the right system boost pump is in the inverted flight compartment of the aft fuel cell. Either boost pump is capable of supplying sufficient fuel to both engines throughout the IDLE to MAX power range with the fuel system in crossfeed operation. If both boost pumps are inoperative, sufficient fuel will flow by gravity to maintain maximum afterburner power from sea level to 6000 feet. Sufficient fuel may flow by gravity to maintain maximum power to 25,000 feet. Reduced power and flight at the lowest practical altitude for terrain clearance and emergency requirements will further assure continued stable engine operation with boost pumps inoperative. Crossfeeding is not available with both boost pumps inoperative.

FUEL FLOAT SWITCHES

A low level float switch in each internal system closes when the fuel level drops to 400 pounds. A time delay relay is energized and after 10 seconds, if the fuel quantity has not gone above 400 pounds, the respective fuel low caution light comes on, and the autobalance holding solenoid for the opposite system is deactivated. For example, when the autobalance switch is at the left low position and fuel low level float switch in the right system closes, the autobalance switch will return to the center position.

Fuels

JP-4 (NATO F-40) is the primary fuel; however, in areas where JP-4 is not available, JET A-1 w/FSII (icing inhibitor) (NATO F-34) can be used as an alternate fuel. JP-8 (NATO F-34) may be substituted for JET A-1 w/FSII. JET A-1 w/FSII can be used as a primary fuel provided each engine main fuel control is maintenance adjusted to provide proper minimum fuel flow and acceleration schedule. If JP-4 is used in aircraft with the main fuel controls adjusted for JET A-1 w/FSII, then JP-4 is considered an alternate fuel. JP-5 (NATO

FUEL SYSTEM (TYPICAL)

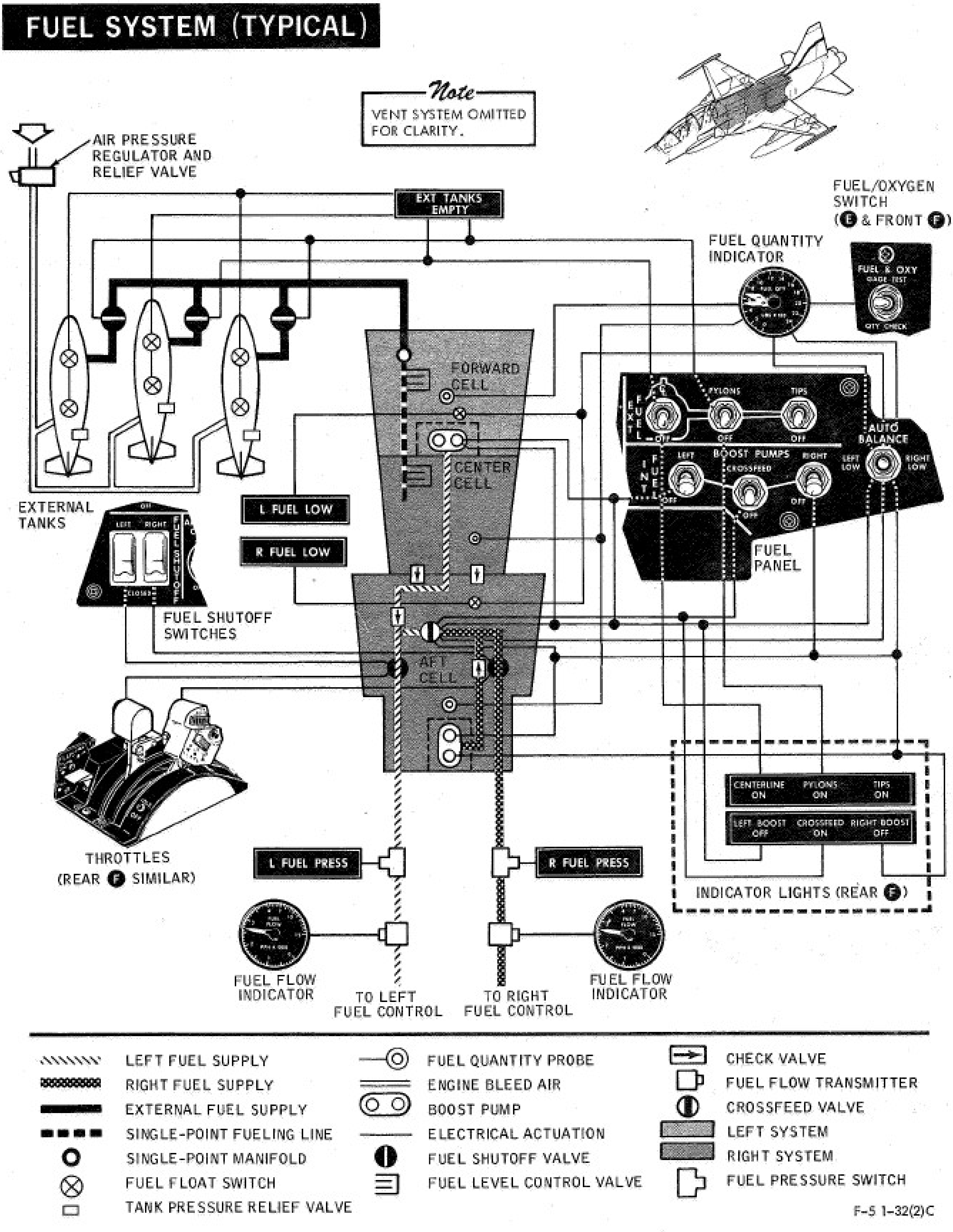


Figure 1-34.

F-44) and JET A-1 w/o FSII (NATO F-35) are considered emergency fuels. See section III for airstart envelopes to be used with the respective fuels and section V for limitations when using alternate or emergency fuel.

FUEL SYSTEM MANAGEMENT

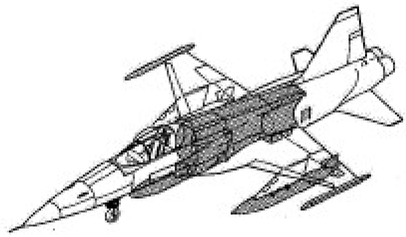
Fuel balancing is required on each flight because the right (AFT) system has a greater fuel capacity than the left (FWD) system (see figure 1-35 for fuel quantity data) and because the engines may use fuel at different rates causing unequal fuel quantities. During flight, check indicated fuel quantities against known or expected quantities at preplanned flight stages and check fuel quantity gages for proper operation with the FUEL/OXY switch (see figure 1-36 for location and function of controls and indicators). If a malfunctioning indicator is suspected or discovered, fuel quantity can be estimated by using available information such as opposite system quantity and/or estimated by using fuel consumption vs time. Do not select autobalance or manual crossfeed operation to avoid possible dual engine flameout caused by fuel starvation.

Autobalance Operation

Autobalance operation is initiated by pulling the autobalance switch out of detent and positioning it to the left or right low position corresponding to the internal system with the lower fuel quantity. The switch is held at the selected position by a holding solenoid. Selecting the left low position opens the crossfeed valve and reverses rotation of the left boost pump to permit fuel feeding from the right system to both engines. Selecting right low position opens the crossfeed valve and turns off the right boost pump to permit fuel feeding from left system to both engines. Autobalance operation ceases when: (1) fuel quantity indicator pointers are within 50 to 125 pounds; (2) the low level float switch in the system supplying fuel closes for longer than 10 seconds, or; (3) the crossfeed switch is positioned to CROSSFEED. When autobalance operation ceases, the holding solenoid is deenergized, allowing the autobalance switch to return to center, the low system boost pump will resume normal operation, and the crossfeed valve will automatically close (unless the crossfeed switch has been positioned to CROSSFEED). Maneuvering flight may produce fuel sloshing sufficient to affect fuel quantity indicator pointers and low level float switches and could cease autobalance operation prematurely.

FUEL QUANTITY DATA (TYPICAL)

	FULLY SERVICED			USABLE		
	GAL	POUNDS		GAL	POUNDS	
INTERNAL FUEL		JP-4	JET A-1 OR JP-8		JP-4	JET A-1 OR JP-8
TOTAL	698	4537	4676	677	4400	4536
LEFT (FWD) SYSTEM	306	1989	2050	296	1924	1983
RIGHT (AFT) SYSTEM	392	2548	2626	381	2476	2553
EXTERNAL FUEL						
CL TANK (275-GALLON)	275	1788	1843	273	1775	1829
2 WING TANKS (275-GALLON) *	550	3575	3685	546	3549	3658
CL TANK (150-GALLON)	152	988	1018	150	975	1005
2 WING TANKS (150-GALLON)	304	1976	2037	300	1950	2010
MAXIMUM FUEL						
INTERNAL AND 3 275-GALLON EXTERNAL TANKS *	1523	9900	10,204	1496	9724	10,023
INTERNAL AND 3 150-GALLON EXTERNAL TANKS	1154	7501	7731	1127	7325	7551



DATA BASIS
- CALIBRATED
- STANDARD DAY
- FUEL:
  - JP-4 6.5 LB/US GAL
  - JET A-1 W/FSII OR JP-8 6.7 LB/US GAL

* IF SARGENT-FLETCHER 275-GAL WING TANKS (IDENTIFIED BY SIGHT WINDOW BELOW MANUAL FILLER CAP ON RIGHT AFT SIDE OF TANK) ARE CARRIED, REDUCE TOTAL QUANTITIES AS FOLLOWS:
26 US GAL
169 LB/JP-4
174 LB/JET-A1 OR JP-8

F-5 1-54(1)D

Figure 1-35.

FUEL SYSTEM CONTROLS / INDICATORS (TYPICAL)

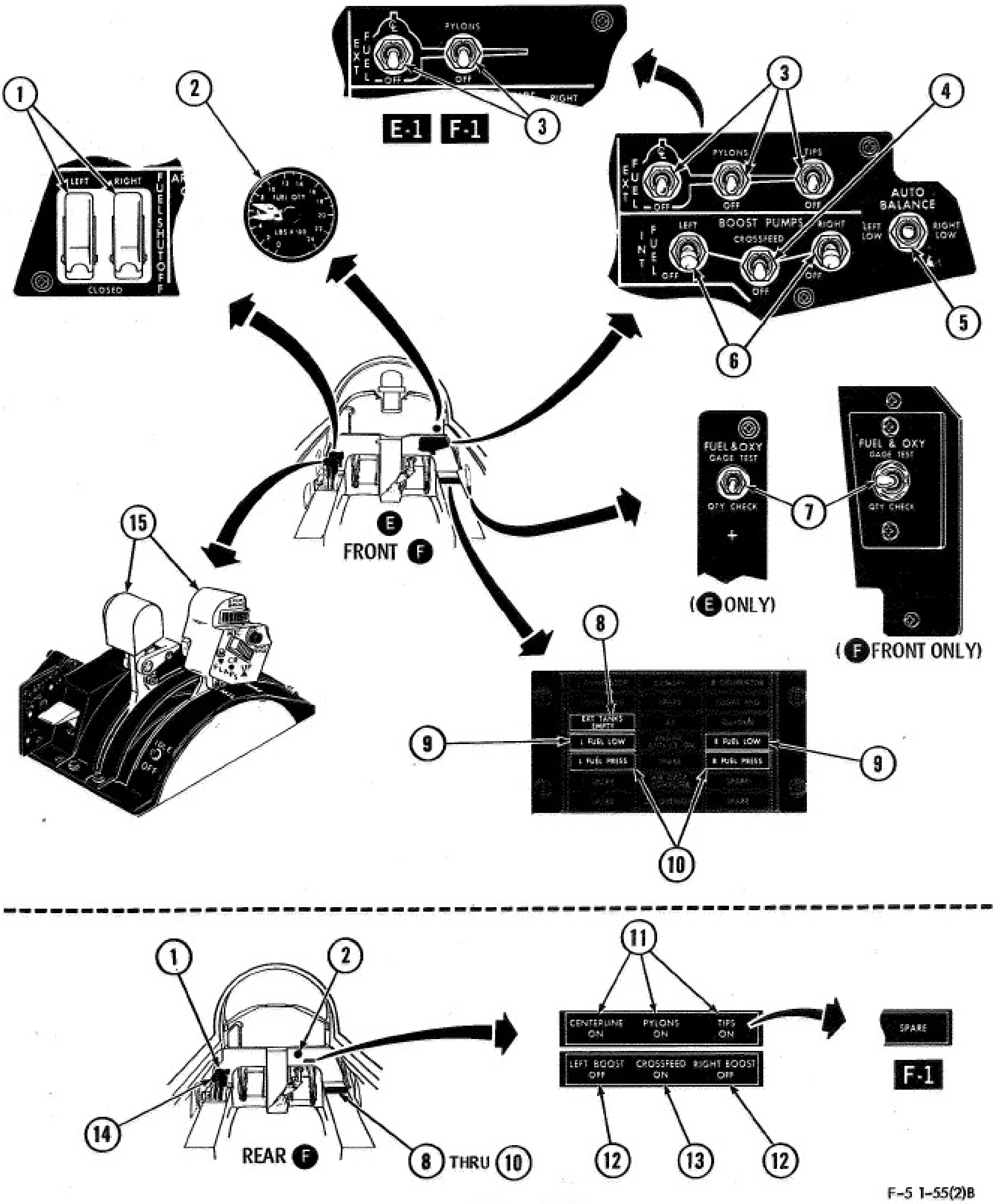


Figure 1-36.

FUEL SYSTEM CONTROLS/INDICATORS (Figure 1-36)

CONTROLS/INDICATORS	FUNCTION	
1 FUEL SHUTOFF Switches (L&R) (Guarded)	CLOSED	— (Guard Open) Shuts off fuel to engine by closing corresponding fuel shutoff valve, regardless of throttle position.
	LEFT/ RIGHT	— (Guard Closed) Fuel shutoff valves controlled by throttle.
2 FUEL QUANTITY Indicator (L&R Pointers)	Indication	— Each pointer indicates pounds of usable fuel in respective internal fuel system. Also centers auto-balance switch when pointers aligned within 50 to 125 pounds, when autobalance is used. Capacitance type ac-operated.
3 EXT FUEL Transfer Switches (Ⓕ Front Cockpit)	OFF	— Closes fuel shutoff valve(s) in pylon(s).
	CL & PYLONS	— Opens fuel shutoff valve(s) in pylon(s) for transfer of fuel to internal system.
	TIP	— (Switch not used.)
4 CROSSFEED Switch (Ⓕ Front Cockpit)	OFF	— Closes crossfeed valve.
	CROSS-FEED	— Opens crossfeed valve to provide one of the following: a. Fuel supply to both engines from one boost pump. b. Fuel supply to one engine from both boost pumps. c. Gravity fuel flow from both internal systems to one engine if both boost pumps fail. d. Shuts off autobalance system and discontinues automatic crossfeeding, if selected.
5 AUTO BALANCE Switch (Springloaded to Detented Center Position) (Ⓕ Front Cockpit)	Center (Off)	— Crossfeed valve closed.
	L (LEFT) LOW	— Opens crossfeed valve and reverses rotation of left boost pump to provide fuel feeding from right internal system. Turns on Ⓕ rear cockpit CROSSFEED ON and LEFT BOOST OFF lights.
	R (RIGHT) LOW	— Opens crossfeed valve and turns off right boost pump to provide fuel feeding from left internal system. Turns on Ⓕ rear cockpit CROSSFEED ON and RIGHT BOOST OFF lights.
6 BOOST PUMP Switches (L&R) (Ⓕ Front Cockpit)	OFF	— Turns off boost pump. Pull out and push down.
	LEFT/ RIGHT	— Turns on boost pump.
7 FUEL & OXY Switch (Spring-loaded to center) (Ⓕ Front Cockpit)	GAGE TEST	— Fuel and oxygen quantity indicator pointers rotate counterclockwise toward zero. (Pointer rotation provides operational check of static inverter on ground or during flight, and oxygen caution light will illuminate when pointer reaches 0.5 liter.)
	QTY CHECK	— Indicators total internal fuel and oxygen quantities.

FUEL SYSTEM CONTROLS/INDICATORS (Figure 1-36) (Continued)

	CONTROLS/INDICATORS	FUNCTION	
8	EXT TANKS EMPTY Caution Light	On	— Fuel transfer from external tanks group completed (CL or both wing inboard tanks). Placing EXT FUEL transfer switch(es) at OFF turns light out.
9	L and R FUEL LOW Caution Lights	On	— Fuel remaining in respective internal system is approximately 400 pounds or less for longer than 10 seconds or aircraft is placed in negative-G condition for 10 seconds or longer.
10	L and R FUEL PRESS Caution Lights	On	— Low-pressure warning indicates a pressure of 6.5 psi or less.
11	(F) CENTERLINE, PYLON, TIPS Indicator Lights (Rear Cockpit)	ON	— Respective external fuel transfer switch(es) in the front cockpit are on (up).
12	(F) LEFT BOOST OFF & RIGHT BOOST OFF Indicator Light (Rear Cockpit) (Yellow)	ON	— Respective boost pump switch in front cockpit is at OFF position, or AUTOBALANCE switch is at LEFT LOW or RIGHT LOW.
13	(F) CROSSFEED ON Indicator Light (Rear Cockpit) (Yellow)	ON	— Crossfeed switch in front cockpit is at CROSSFEED position, or autobalance crossfeed system has opened crossfeed valve.
14	THROTTLES (L&R)	OFF	— Shuts off fuel by closing fuel shutoff valve.
		IDLE	— Provides fuel by opening fuel shutoff valve.
		MIL	— Operates engine at military power.
		MAX	— Operates engine at maximum power.

NOTE

- Crossfeed switch must be at OFF and boost pump switches at LEFT and RIGHT for autobalancing to function.
- Intentional zero- or negative-g conditions should be avoided during crossfeed or gravity feed operation due to the probability of uncovering one or both boost pump inlets and the possibility of engine flameout due to fuel starvation.

Manual Crossfeed Operation

Manual crossfeed is accomplished by turning the crossfeed switch on to open the crossfeed valve and turning off the boost pump switch of the system with the lower fuel quantity. When the fuel quantities of both systems indicate within 100 pounds of each other, the boost pump switch that is off should be turned on. After the pump has operated for a minimum of 2 minutes, turn the crossfeed switch OFF. If the switches are not repositioned after the systems indicate balanced, the systems will become unbalanced in the opposite direction.

Low Fuel Operation

If an internal fuel system has less than 650 pounds of fuel, the quantity of fuel falls below the fuel boost pump upper-inlet and the boost pump output is reduced approximately 40%. During crossfeed operation, if the engines are operated at power settings requiring a fuel flow of 6000 pounds per engine per hour or greater, the low pressure light may come on and engine rpm fluctuations may occur because of insufficient fuel pressure. With a low fuel state (approximately 400 pounds), do not attempt to ensure fuel flow to both engines by selecting crossfeed operation with both fuel boost pumps operating. If the fuel supply in one system is depleted, or is pulled away from the boost pump by g-forces and the boost pump in the other system fails, air may be supplied to engines causing dual engine flameout. There is no cockpit indication of boost pump failure.

External Fuel Sequencing

When external tanks are carried, use inboard tanks first, centerline tank next, and internal fuel last. During ground operation, delay or stop transfer of external fuel when either the left system indicates 1700 lbs or more, or right system indicates 2300 lbs or more. When inboard tanks are empty (indicated when EXT TANKS EMPTY caution light comes on), check fuel quantity indicator for a decrease in quantity to assure that inboard tanks are empty. To transfer centerline tank fuel, turn off PYLONS fuel transfer switch and turn on CL fuel transfer switch. Failure to turn off the fuel transfer switch when inboard tanks are empty prevents EXT TANKS EMPTY light from indicating when the centerline tank is empty. The light will remain on until the switch is turned off.

NOTE

Fuel balancing should be delayed until external fuel transfer is complete.

Fuel Venting

Fuel may vent overboard if fuel level shutoff valves in the internal system fail while transferring fuel from external tanks.

WARNING

Fuel venting during ground operation is a fire hazard.

If fuel venting occurs on ground or in flight, discontinue fuel transfer from external tank until fuel quantity indicator indicates less than total capacity. If in a climb, level aircraft and do not climb to a higher altitude until internal fuel quantities have been reduced.

JETTISON SYSTEM

The external stores may be salvo or selectively jettisoned from the pylons. The system consists of an aircraft battery-powered emergency all jettison and select jettison system, and (EXCEPT [E-1] [F-1]) a one-shot thermal battery-powered emergency jettison system. Controls consist of an emergency all jettison button, a select jettison switch and button, and (EXCEPT [E-1] [F-1]) an external stores jettison T-handle. Stores and pylons may be jettisoned on the ground or in flight with the gear up or down. See figure 1-37 for schematic and location of controls. Refer to T.O. 1F-5E-34-1-1 for jettison of other stores and missiles.

STORES SALVO-JETTISON

When the emergency all jettison button or the external stores jettison T-handle (if installed) is actuated, a time delay in the system will sequence the outboard stores first, the centerline store 200 milliseconds later, and inboard stores or empty fuel tanks 300 milliseconds later (or 800 milliseconds later for tanks containing fuel).

SELECT JETTISON SWITCH AT SELECT POSITION

The centerline store, any wing store, or paired wing store (both outboard or both inboard) may be jettisoned individually. Only one release or paired release will occur for each actuation of the select jettison button. The released station or stations must be deselected before another store can be jettisoned.

SELECT JETTISON SWITCH AT ALL PYLONS

A single actuation of the select jettison button jettisons wing and centerline stores and also actuates the pylon jettison circuits. If pylons are jettisoned with stores, the stores will jettison from the pylons first followed by the pylons 1 second later.

WARNING

- Following an attempted release or jettison, any munition that does not separate from the aircraft should be considered armed and susceptible to inadvertent release during landing.
- Jettison control circuit breaker must be in for emergency all jettison button or select jettison button to operate.

NOTE

Pylons will jettison only if equipped with necessary hardware and explosive bolts.

JETTISON SYSTEM

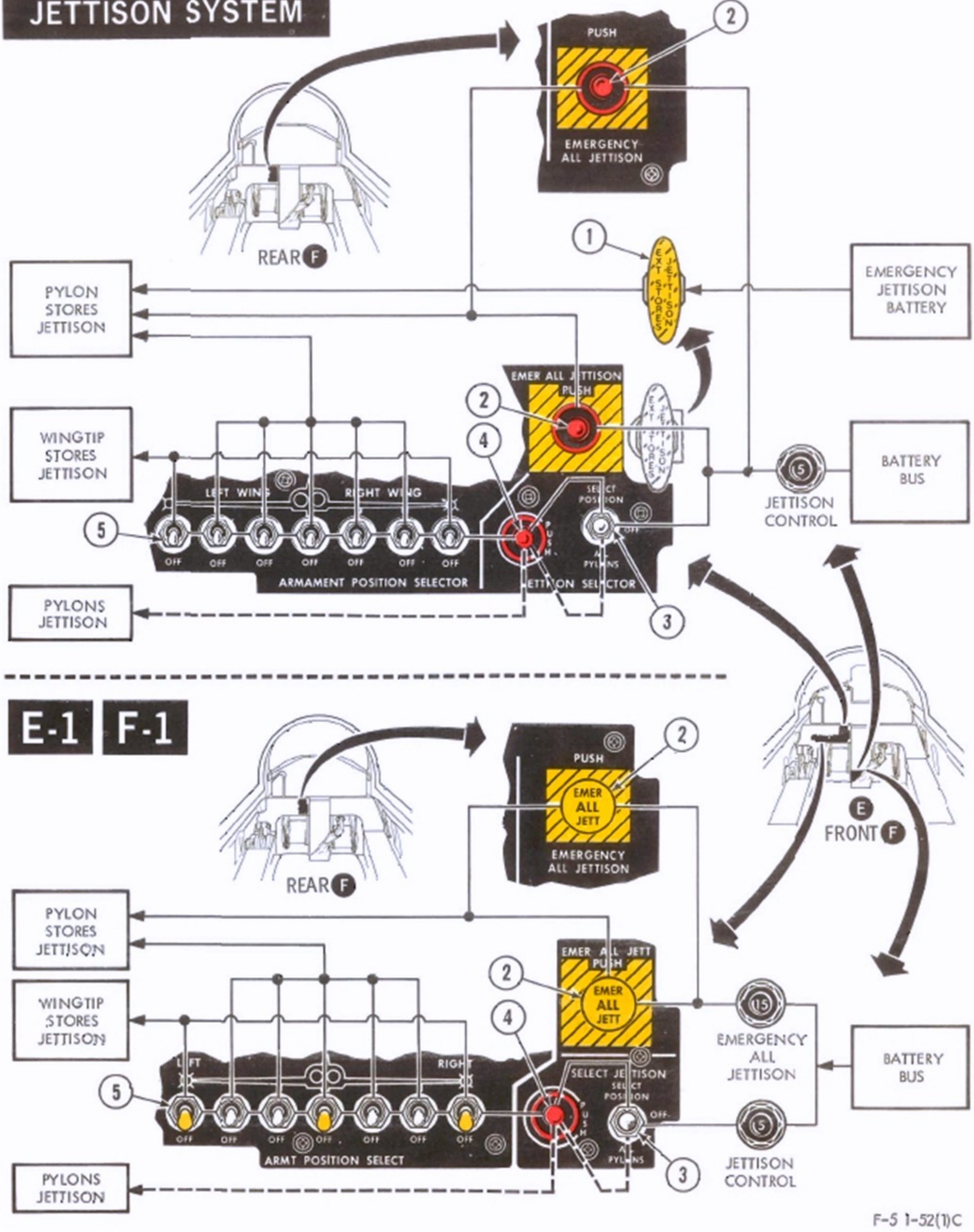


Figure 1-37.

JETTISON SYSTEM CONTROLS (FIGURE 1-37)

CONTROLS/INDICATORS	FUNCTION	
1 External Stores Jettison T-Handle (EXCEPT E-I F-I)	Pull	— Connects thermal battery power to electrically salvo-jettison stores in safe condition from all pylons, bypassing all armament control selections.
2 Emergency All Jettison Button	PUSH	— Connects aircraft battery bus power to electrically salvo-jettison stores in safe condition from all pylons, bypassing all armament control selections.
3 Select Jettison Switch	SELECT POSITION	— Completes stores jettison electrical circuits to pylons or wingtip launchers selected by armament position selector switch(es). Switch must be pulled out and up.
	OFF	— Disconnects electrical power to select jettison circuits. **NOTE** Switch must be at OFF for normal release/ firing circuits to function.
	ALL PYLONS	— Completes pylon jettison electrical circuits to all pylons. Switch must be pulled out and down.
4 Select Jettison Button	PUSH	— a. With select jettison switch at SELECT POSITION, connects aircraft battery bus power to electrically jettison selected stores, individually or in pairs, in safe condition from selected pylons and wingtip launchers (fired safe). **NOTE** All armament position selector switches must be off except the switch of the selected station of the store to be jettisoned.
		— b. With select jettison switch at ALL PYLONS, connects aircraft battery bus power to electrically jettison stores in safe condition (if carried) from all pylons followed by jettison of all pylons.
5 Armament Position Selector Switches (7)	OFF	— Opens respective select jettison circuits.
	Up	— Closes respective select jettison circuits.

ELECTRICAL SYSTEM

Electrical power is supplied by two ac systems and one dc system (figure 1-38). An external receptacle is provided for ac power input to the aircraft when the engines are not in operation. DC power is supplied by a battery and two 33-ampere transformer-rectifiers. See figures 1-39 thru 1-48 for cockpit circuit breaker panels.

AC POWER SYSTEM

AC power is supplied by two 13/15 kva 320 to 480 Hz generators, one operating from each engine. Each generator functions independently and supplies 115/200-volt three-phase power to the ac buses. Normally, power distribution is divided between the right and left systems. One generator will automatically assume the full load, except the corresponding aux intake door, without disruption if the other generator is off or inoperative. Generators cut in individually when each engine reaches approximately 48% rpm and should be on the line at engine idle. Generator dropout occurs at approximately 43%.

Generator Switches and Caution Lights

Two switches placarded L GEN and R GEN are on the right vertical panel ((F) front cockpit) (figures 1-15 thru 1-19). Generator caution lights, placarded L GENERATOR and R GENERATOR, on the caution light panel ((F) both cockpits) (figures 1-21 thru 1-26) will come on any time the respective generator fails or is turned off. Each generator switch has a RESET position, permitting the pilot to reset the generators if necessary.

DC POWER SYSTEM

DC power is obtained from each ac system thru a transformer-rectifier which converts ac to dc. A 24-volt, 11-ampere-hour ([E-1] [F-1] [T.O. 1F-5E-611] 13-ampere-hour) nickel-cadmium battery serves as a standby source of power for all dc circuits and is charged by the transformer-rectifiers. If one transformer-rectifier fails, the other continues to supply all dc power. A DC OVERLOAD light ((F) [E-1]) is provided on each cockpit caution light panel. See section III for dc overload emergency procedures.

Battery Switch

The battery switch (figures 1-15 thru 1-19) on the right vertical panel ((F) front cockpit) is a two-position switch placarded BATT and OFF. During normal flight conditions, the switch should remain in BATT position.

NOTE

> If the battery relay does not close when battery switch is placed at BATT, a normal start cannot be accomplished.

STATIC INVERTER

A static inverter, powered by the dc bus, converts 24-volt dc from the battery to 115-volt ac. The inverter, when activated, provides an alternate source of ac power for the following:

a. Engine ignition on the ground or in flight.
b. Operation of left engine instruments during start of left engine.
c. Fuel and oxygen quantity indicators.

On the ground, with dc power only (battery switch at BATT), the inverter is activated when either engine start button is pushed or when the fuel and oxygen check ((F) front cockpit) switch is held at GAGE TEST or QTY CHECK position. In flight, with dual engine flameout (battery switch at BATT), the inverter is activated when either engine start button is pushed or either throttle is moved into AB range for engine restarts, or when the fuel and oxygen check switch is held at GAGE TEST or QTY CHECK position. In flight, with normal ac-dc power, operation of the static inverter can be checked by positioning the fuel and oxygen check switch to GAGE TEST and observing counterclockwise movement of fuel and oxygen quantity indicator pointers.

ELECTRICAL SYSTEM (TYPICAL)

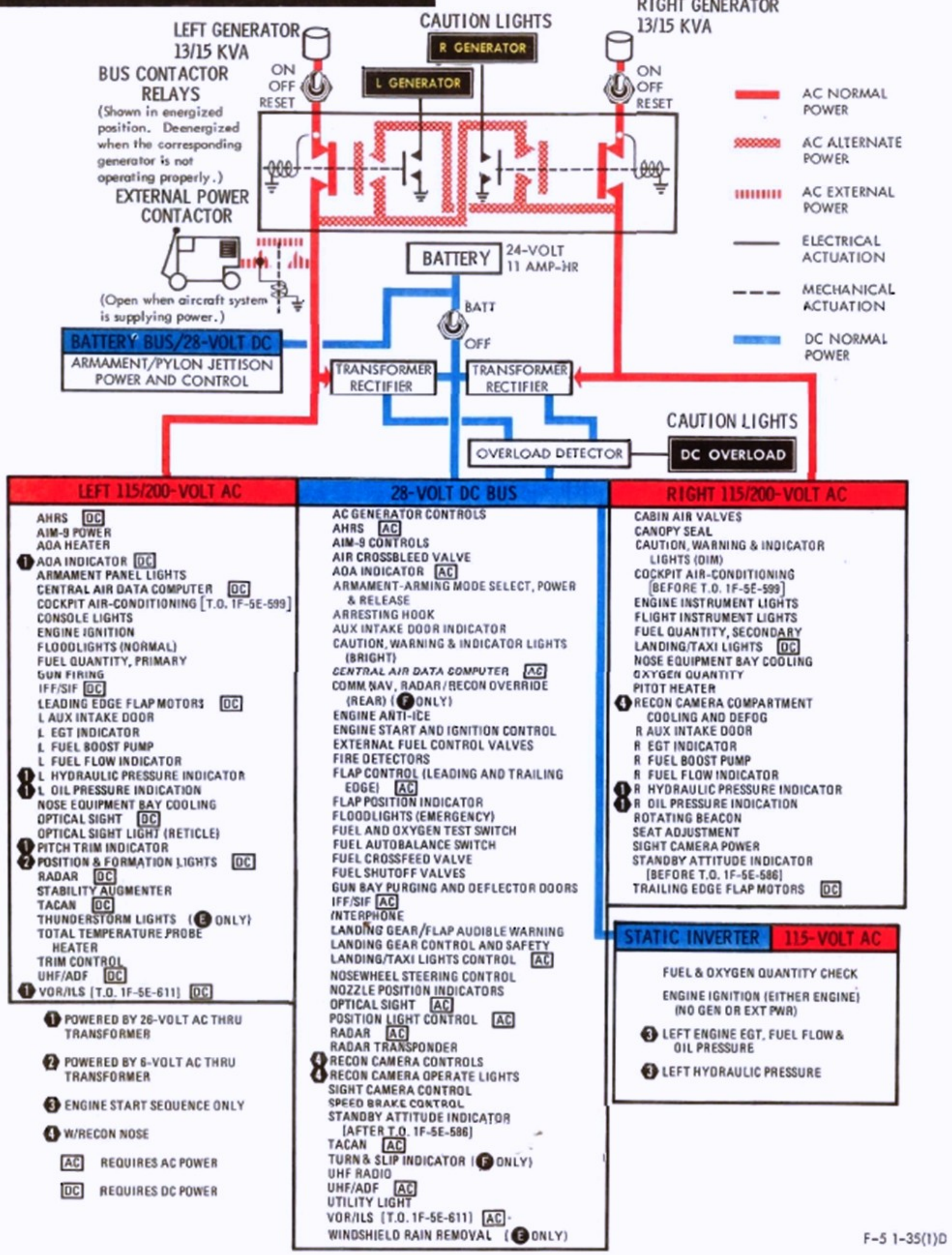


Figure 1-38.

CIRCUIT BREAKER PANELS (TYPICAL)

E EXCEPT E-1

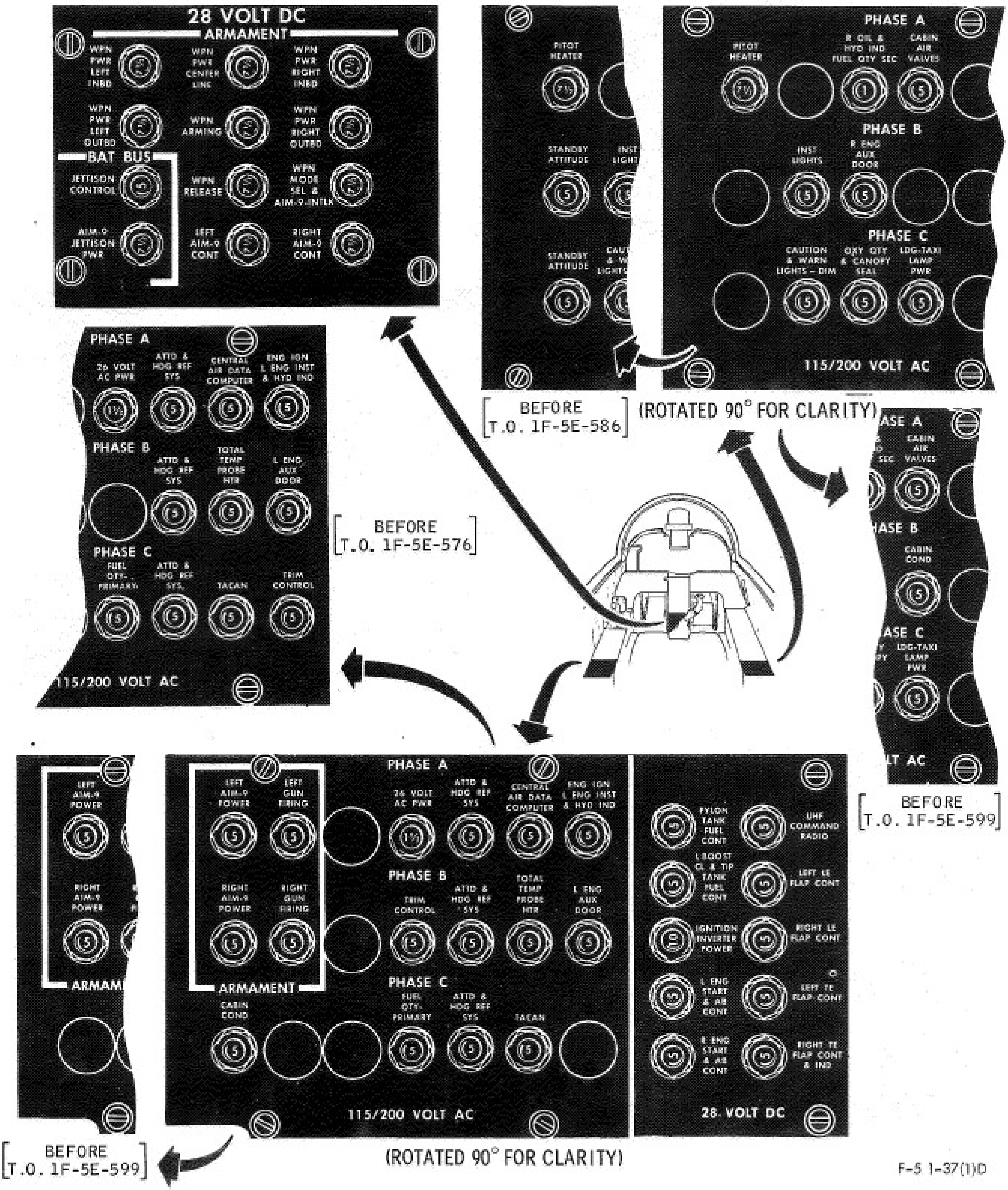
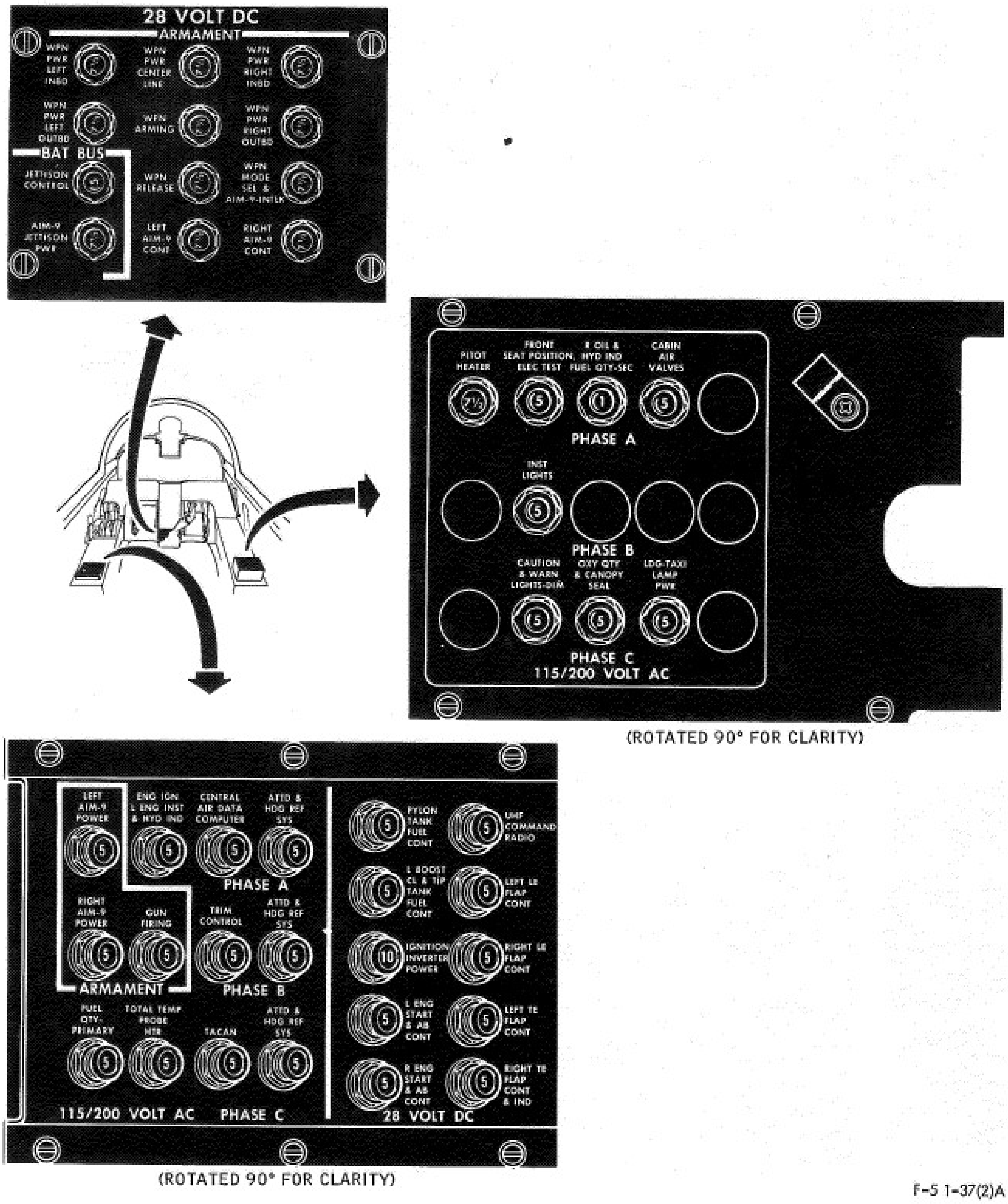


Figure 1-39.

CIRCUIT BREAKER PANELS – FRONT

F EXCEPT F-1

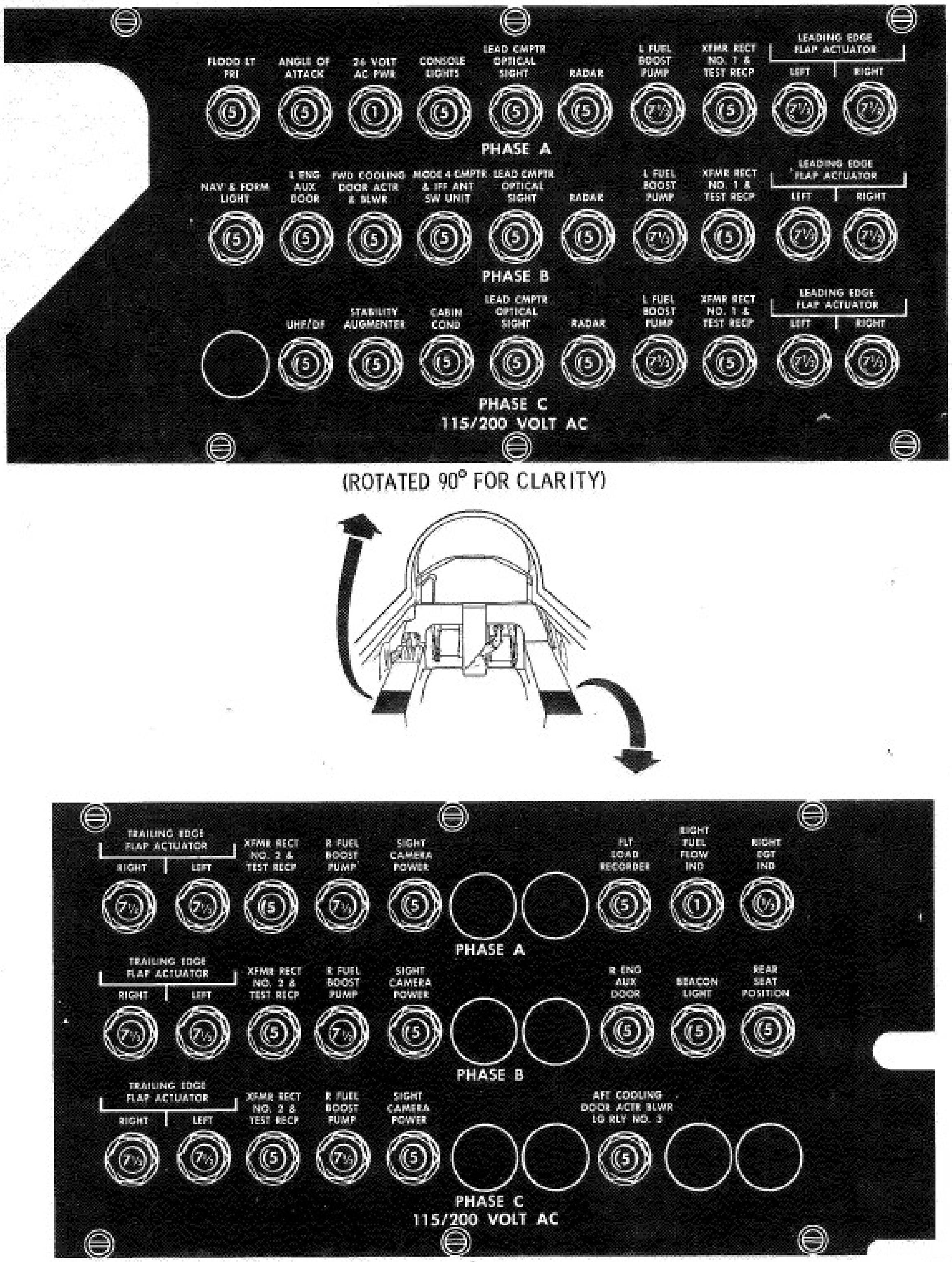


F-5 1-37(2)A

Figure 1-40.

CIRCUIT BREAKER PANELS - REAR

F EXCEPT F-1



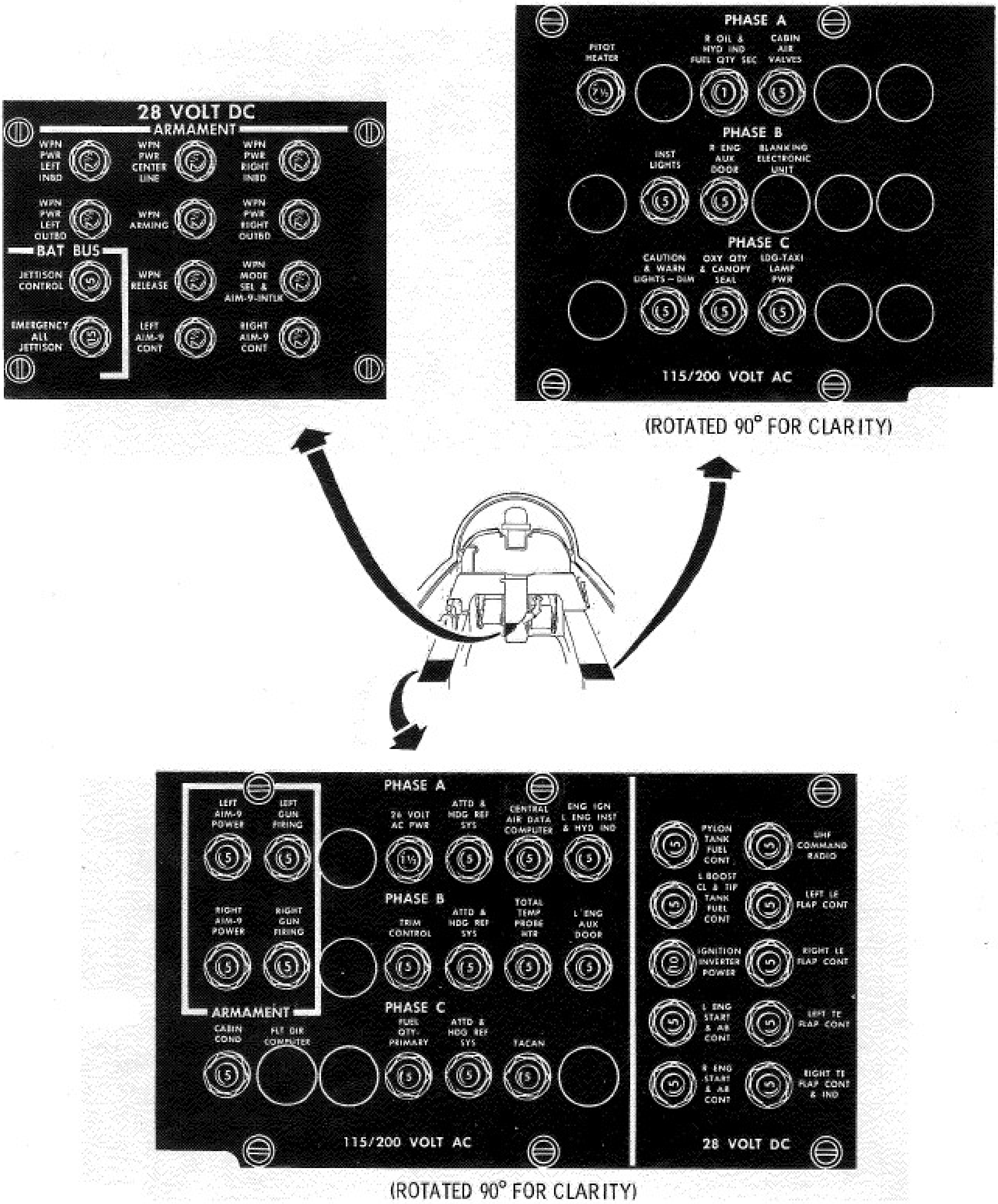
(ROTATED 90° FOR CLARITY)

F-5 1-39(1)A

Figure 1-41.

CIRCUIT BREAKER PANELS

E-1



F-5 1-37(12)

Figure 1-42.

CIRCUIT BREAKER PANELS—FRONT

F-1

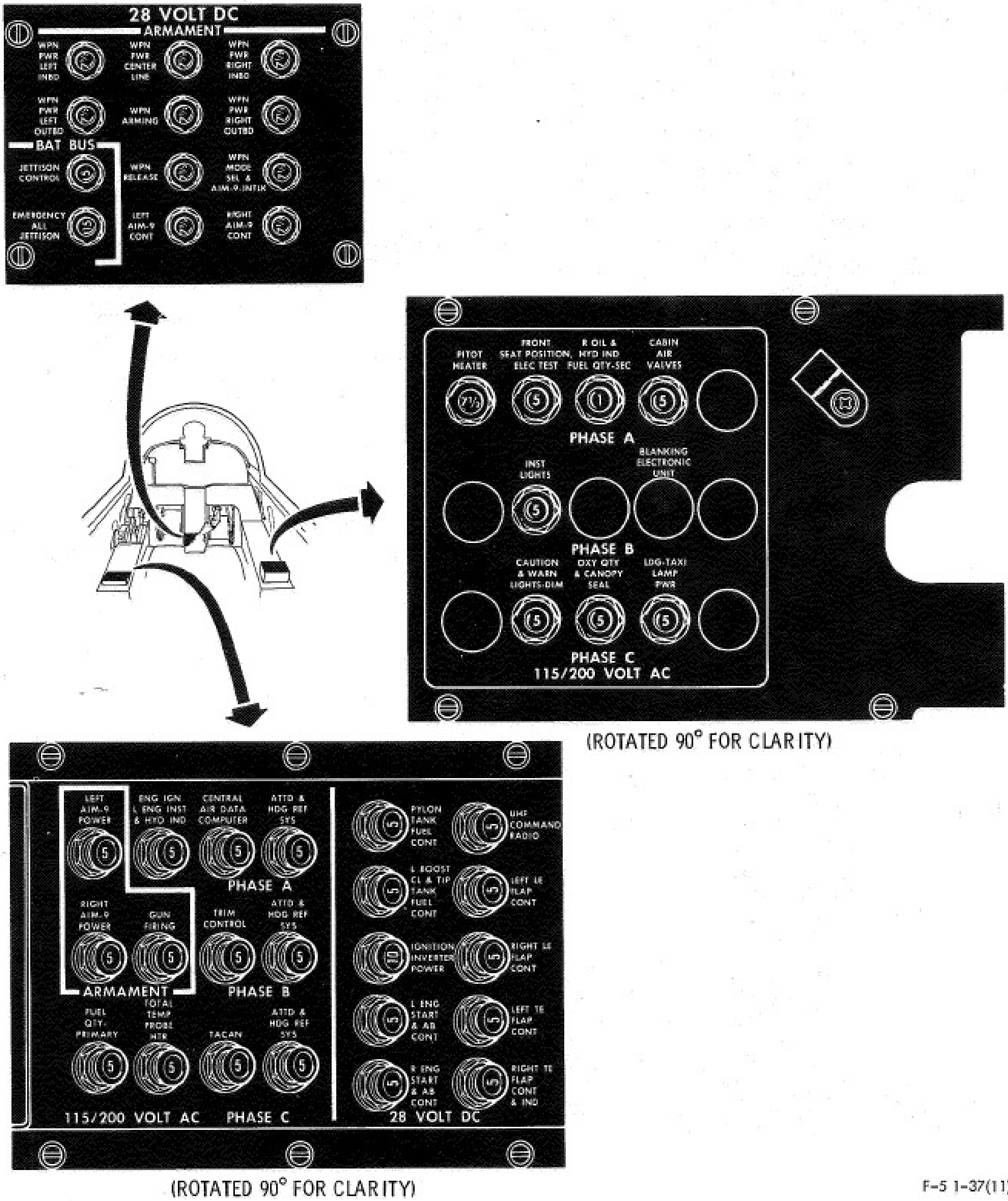
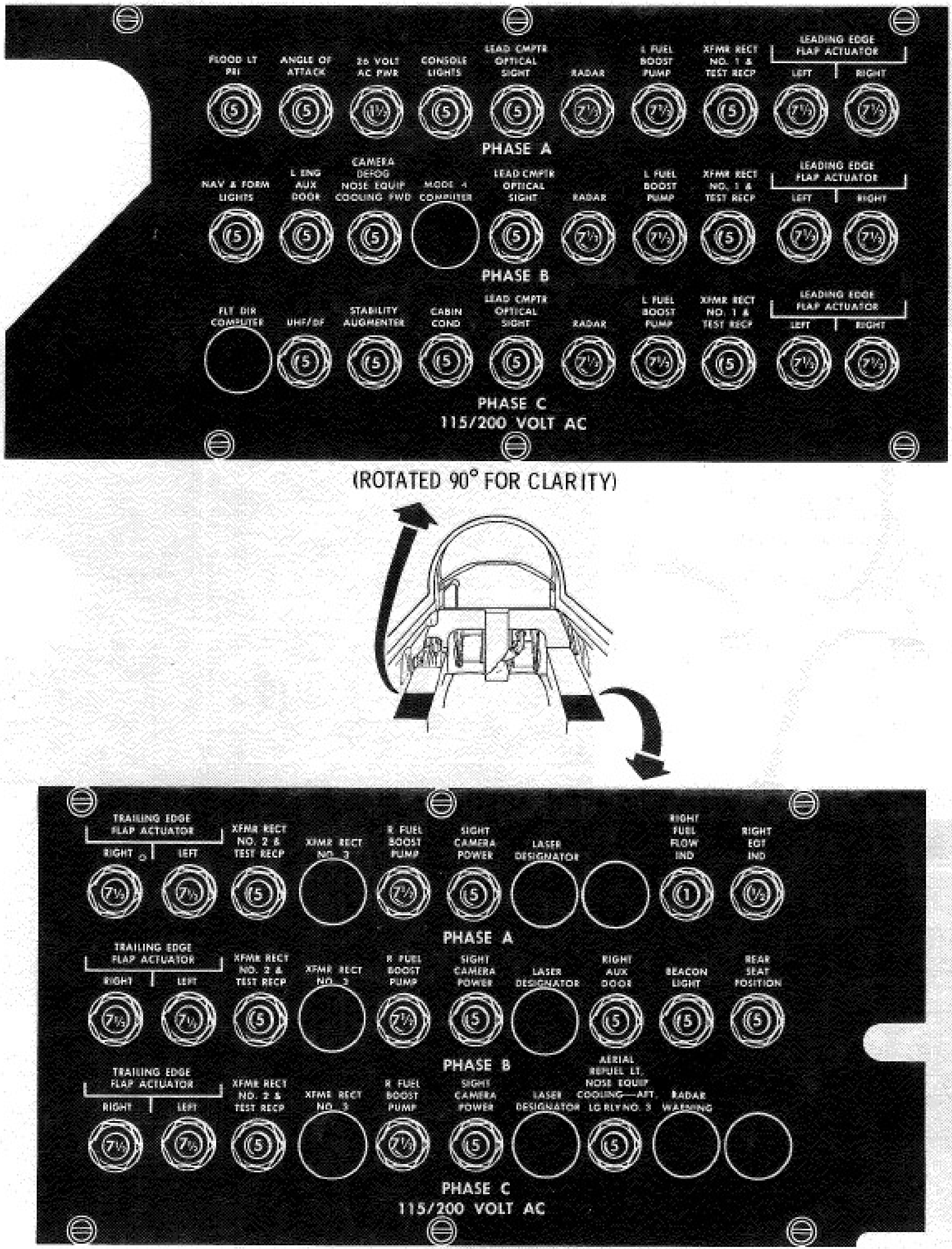


Figure 1-43.

CIRCUIT BREAKER PANELS–REAR

F-1



(ROTATED 90° FOR CLARITY)

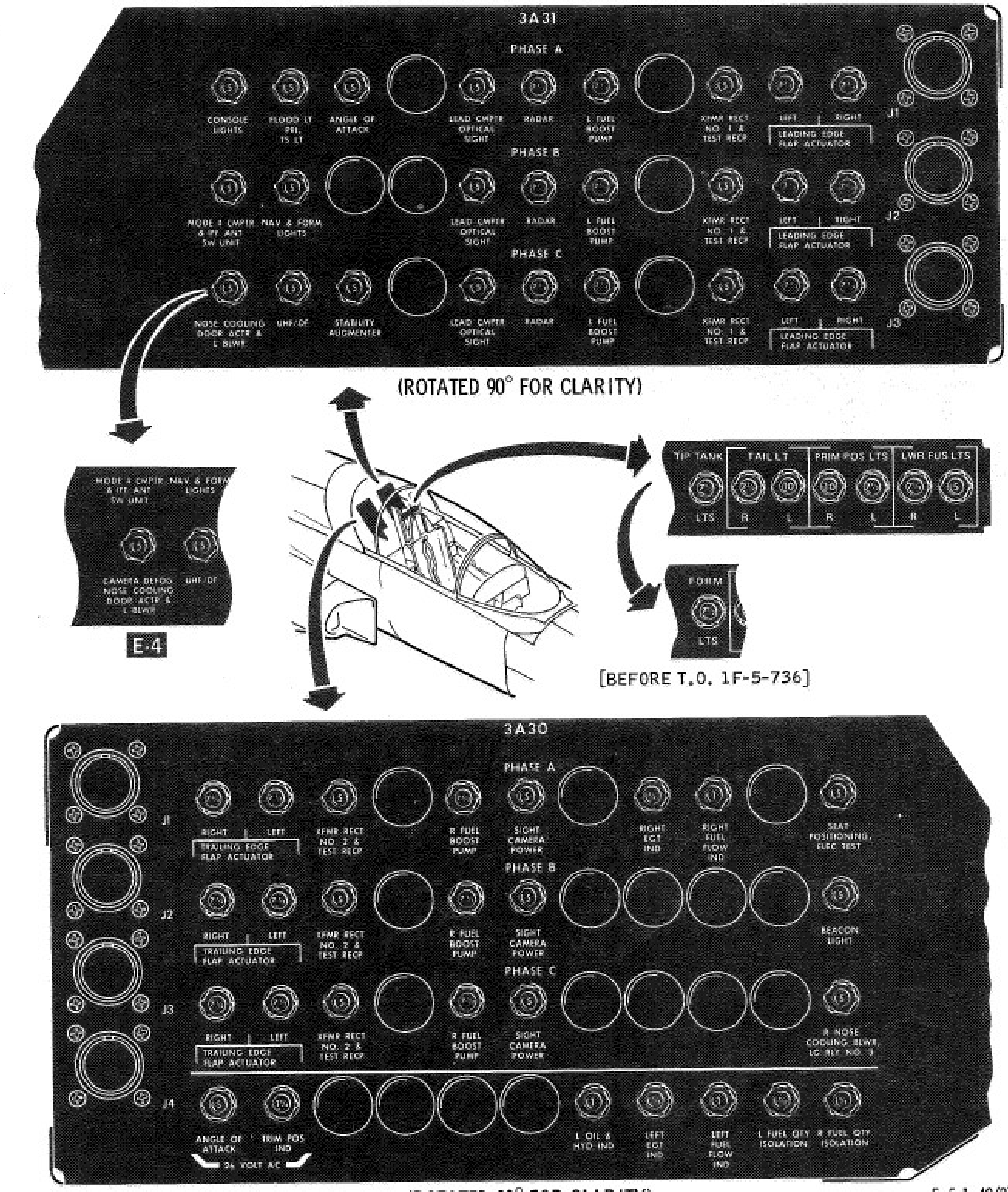
F-5 1-39(4)

Figure 1-44.

CIRCUIT BREAKER PANELS (TYPICAL)

E EXCEPT E-1

BEHIND SEAT



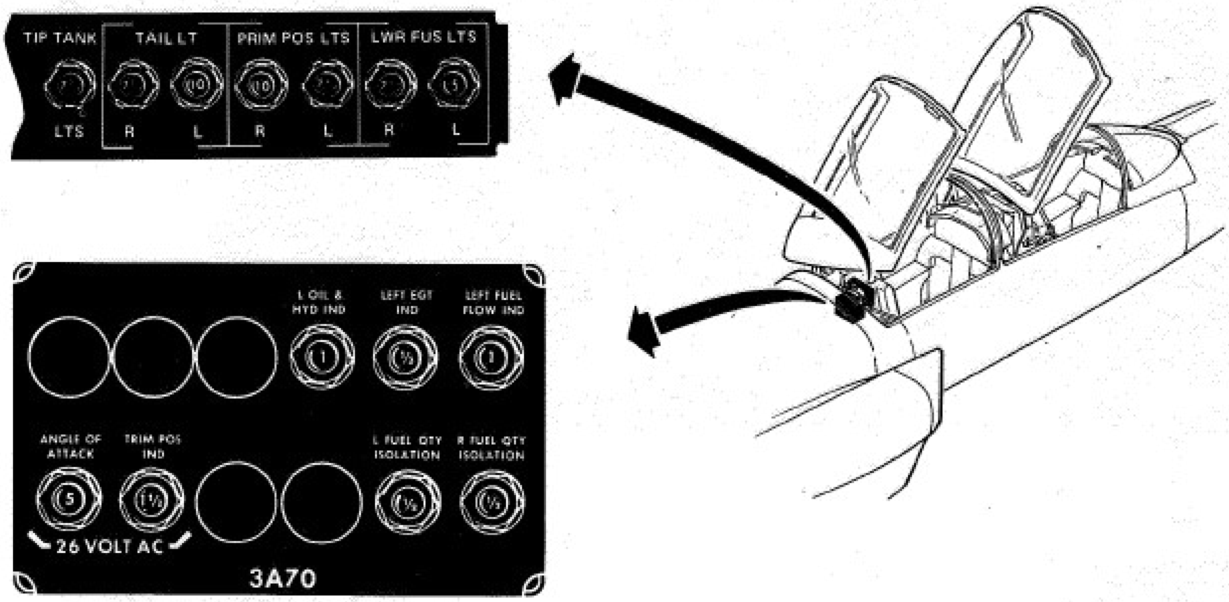
F-5 1-40(2)A

Figure 1-45.

CIRCUIT BREAKER PANELS

F EXCEPT F-1

BEHIND REAR SEAT



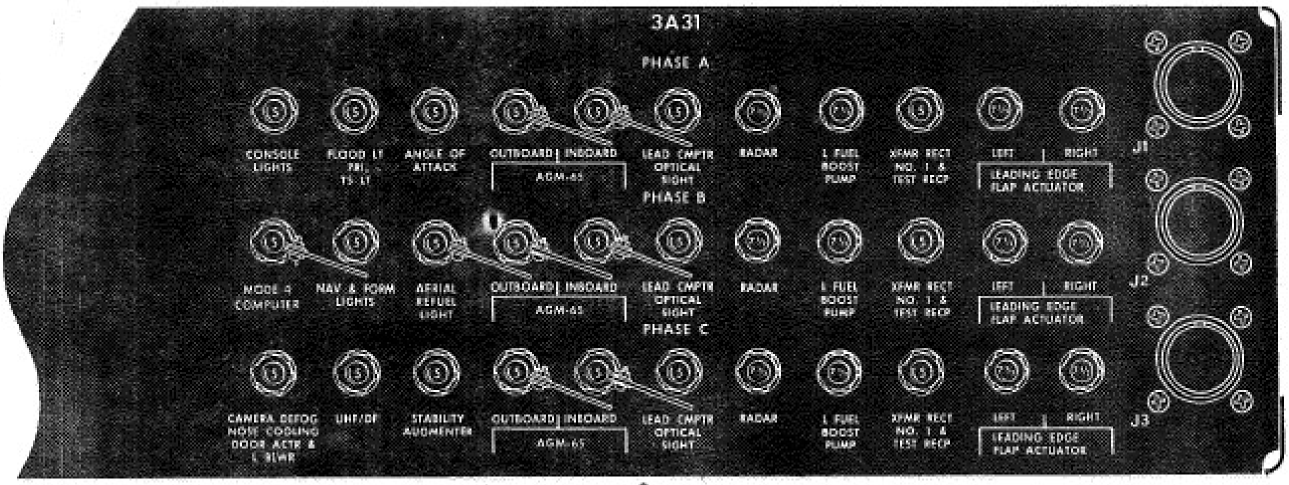
F-5 1-40(1)A

Figure 1-46.

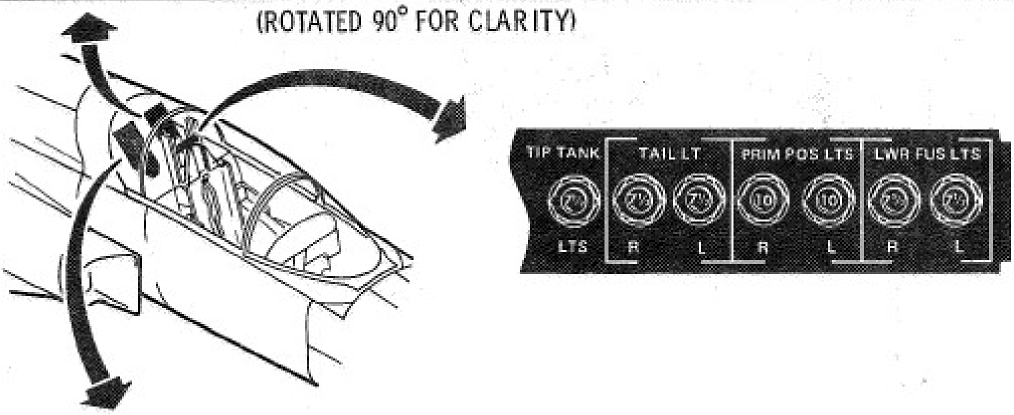
CIRCUIT BREAKER PANELS

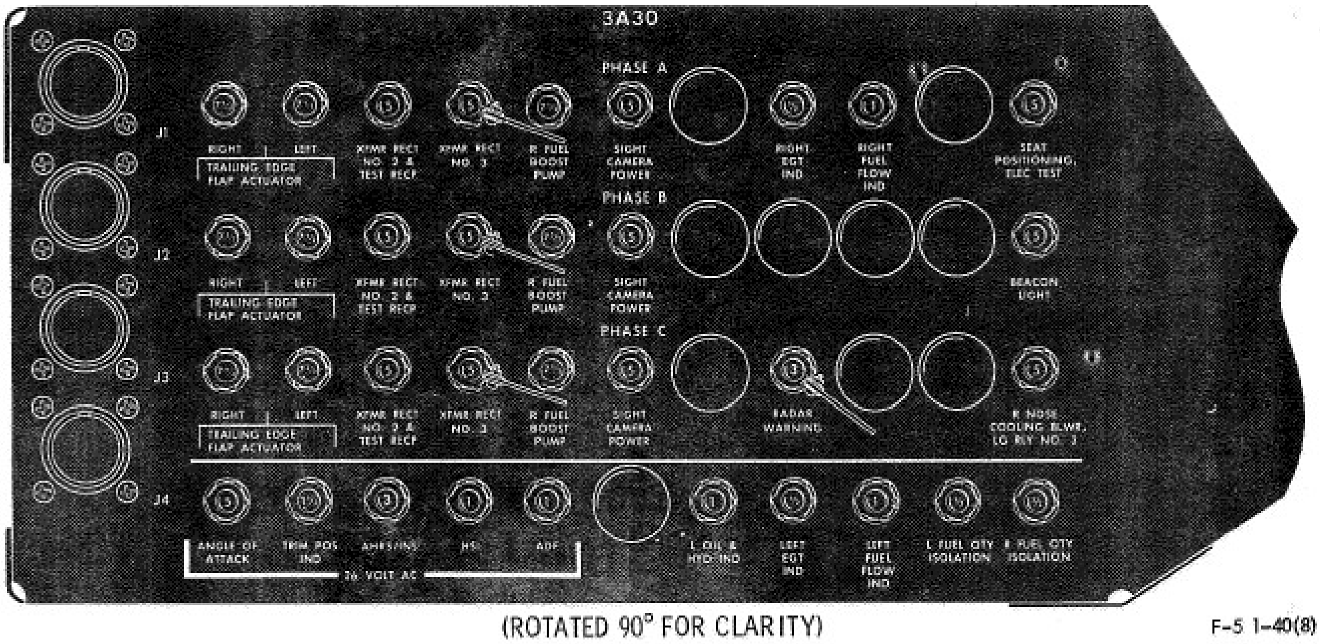
E-1

BEHIND SEAT



(ROTATED 90° FOR CLARITY)





(ROTATED 90° FOR CLARITY)

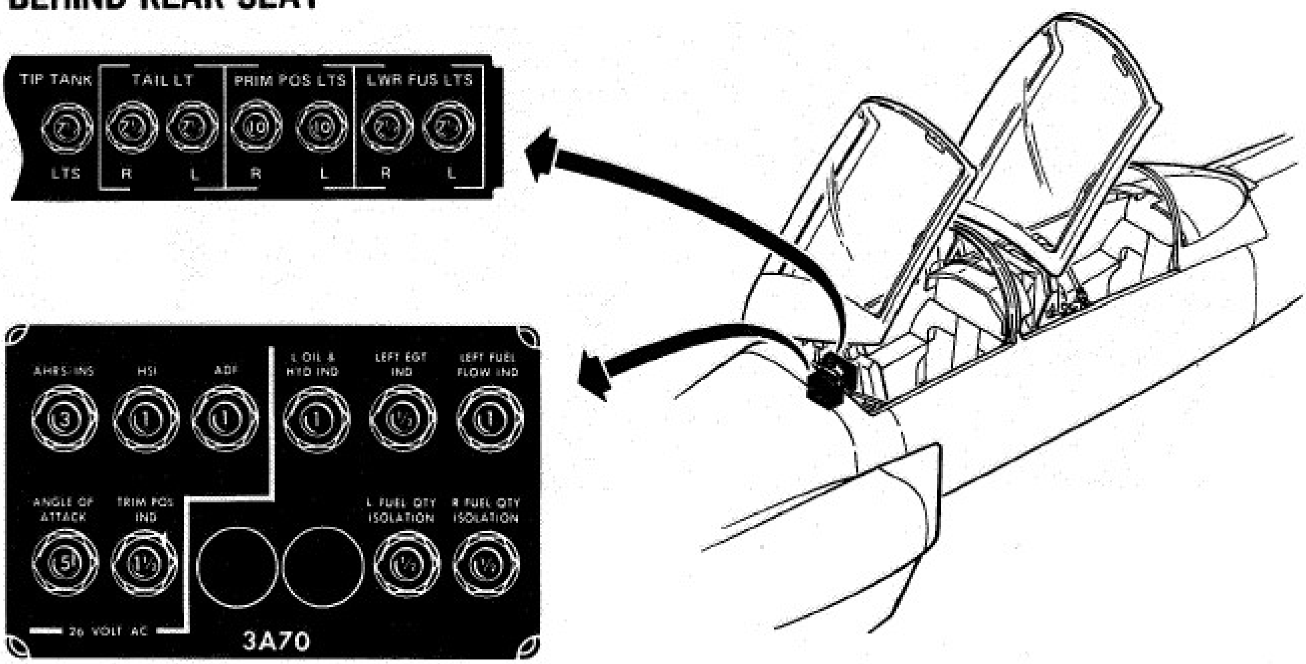
F-5 1-40(8)

Figure 1-47.

CIRCUIT BREAKER PANELS

F-1

BEHIND REAR SEAT



F-5 1-40(7)

Figure 1-48.

HYDRAULIC SYSTEMS

Hydraulic power is supplied by two independent systems, the flight control hydraulic system and the utility hydraulic system (figure 1-49). Each system is powered by a positive displacement piston-type pump. The right airframe-mounted gearbox drives the flight control hydraulic system pump, and the left airframe-mounted gearbox drives the utility hydraulic system pump. Both systems operate at 3000 psi. The flight control and utility hydraulic systems both provide the hydraulic power for the flight controls. In addition, the utility hydraulic system provides the hydraulic power to operate the landing gear, gear doors, speed brake, wheel brakes, stability augmenter, nosewheel steering, two-position nose gear strut, gun gas purge doors, and gun gas deflector doors.

HYDRAULIC PRESSURE INDICATORS

The hydraulic pressure indicators on the instrument panel (Ⓕ rear cockpit right vertical panel) (figures 1-9 and 1-14) provide visual indication of hydraulic pressure in each system. See section V for indicator markings and pressure limits.

HYDRAULIC PRESSURE CAUTION LIGHTS

A hydraulic pressure caution light for each system, placarded UTILITY HYD and FLIGHT HYD, on the caution light panel (figures 1-21 thru 1-26) will come on when the respective system pressure drops to 1500 psi or less to indicate a low-pressure condition. The light will automatically go out when a pressure of approximately 1800 psi is restored.

HYDRAULIC SYSTEMS

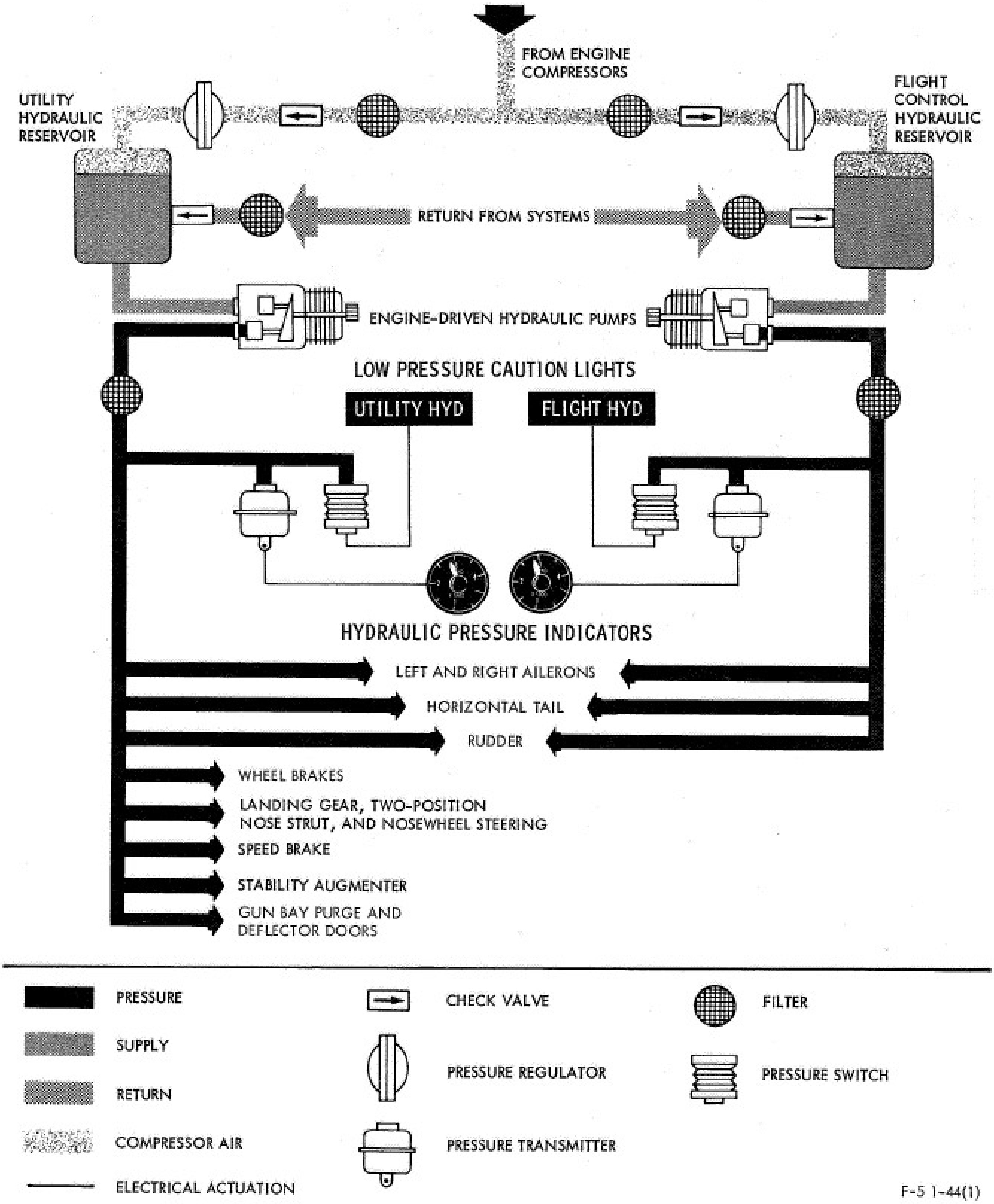


Figure 1-49.

LANDING GEAR SYSTEM

The landing gear system provides normal extension and retraction of gear, alternate extension of gear, nose gear strut hike-dehike, and nosewheel steering. The landing gear is extended and retracted by utility hydraulic system pressure electrically controlled by the landing gear lever (Ⓕ both cockpits). Retraction time is 9 seconds with nose gear strut hiked and 6 seconds with nose gear strut dehiked. Gear extension time is 6 seconds. The main gear is held in the retracted position by individual uplocks hydraulically actuated. The nose gear uplock is contained within the gear dragbrace mechanism. All gears are held down by hydraulic pressure on the gear actuators and locked in the down position by spring-loaded overcenter downlocks. Three green lights, a red warning light, and an audible signal heard thru the headset are provided to indicate when the landing gear is in a safe or unsafe position. A landing gear alternate release is provided in case of utility hydraulic system or electrical malfunction. See figure 1-50 for location and function of all controls and indicators.

NOSE GEAR STRUT HIKE-DEHIKE

The nose gear strut can be extended (hiked) 13 inches or retracted (dehiked) on the ground by the nose strut switch outboard of the throttle quadrant (Ⓕ front cockpit). Full hiking of the strut will add approximately 3 degrees to the angle of attack, which shortens takeoff runs. The nosewheel is steerable in the hiked and dehiked positions; however, steering response may be slower during transit. After takeoff, the strut will dehike automatically before it enters the wheel well.

LANDING GEAR ALTERNATE EXTENSION

A landing gear alternate release D-handle (Ⓕ front cockpit) (figure 1-50) permits gear extension with the landing gear lever up or down should the normal extension system fail. Pulling the handle deenergizes the landing gear hydraulic and electrical systems and releases the main gear uplocks, main gear inboard door locks, nose gear, and nose gear forward door to allow the landing gear to extend, assisted by gravity and airloads. With the gear lever down and all gear fully extended, the red light in the gear handle will go out and the green lights will come on; however the gear doors will remain open. Nosewheel steering is inoperative after alternate extension of the gear.

LANDING GEAR CONTROLS/ INDICATORS (TYPICAL)

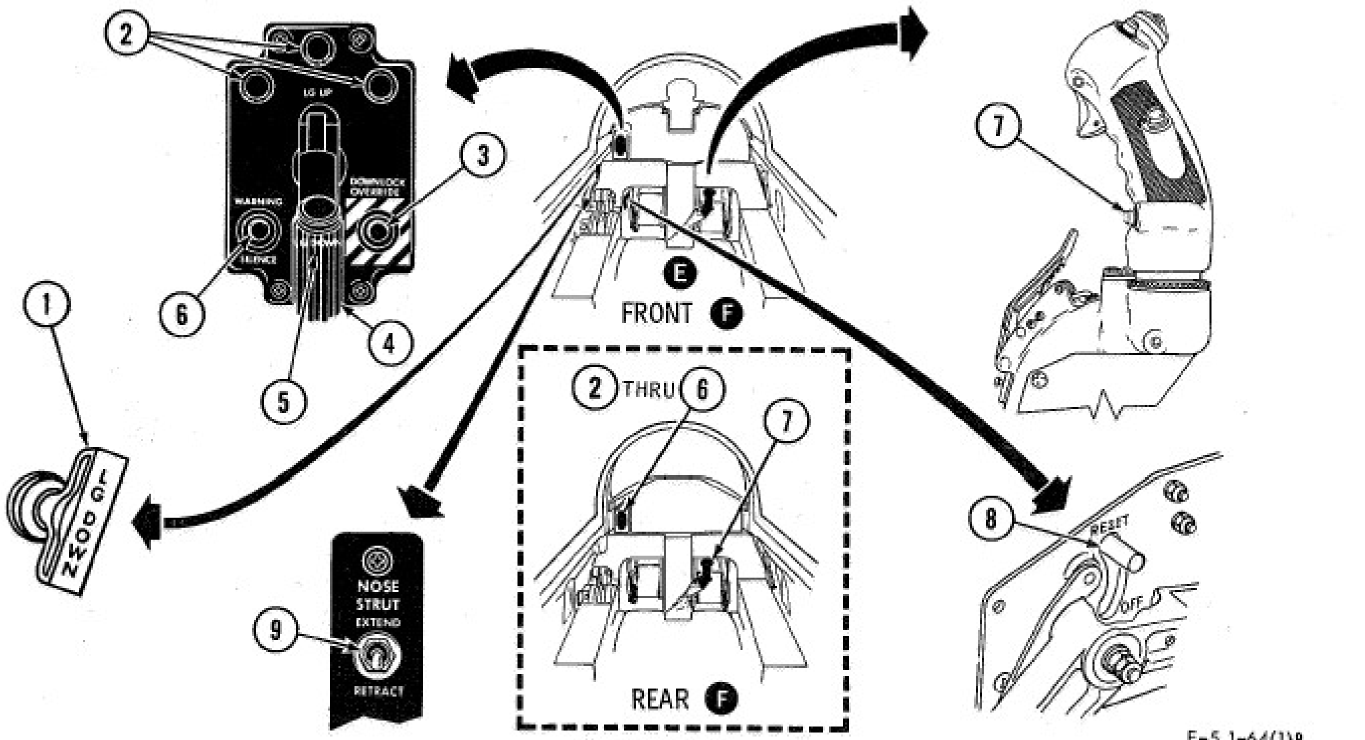


Figure 1-50.

LANDING GEAR CONTROLS/INDICATORS (TYPICAL) (Figure 1-50)

CONTROLS/INDICATORS	FUNCTION	
1 Landing Gear Alternate Release Handle (Ⓕ Front Cockpit)	Pull and Hold— (Until Gear Unlocks)	Extends landing gear (gear lever up or down) in case of malfunction.
2 Landing Gear Position Indicator Lights (Green)	On	— Indicates each respective landing gear is down and locked.
3 Landing Gear Downlock Override Button	Push and Hold	— Overrides locking solenoid to permit raising of gear lever.
4 Landing Gear Lever	LG UP/ LG DN	— Retracts or extends landing gear.
5 Landing Gear Lever Warning Light (Red)	On	— a. Indicates one or more gear unsafe. b. Indicates one or more gear doors open when landing gear lever is up. c. The red light and audible warning beeper will activate at altitudes below 9500 feet, at an airspeed less than 210±10 KIAS, with one or both throttles retarded below approximately 96% rpm. d. The red light will come on and the audible beeper will sound when the landing gear lever is down and the gear door switch in the wheel well is used to open the main gear doors.
6 Landing Gear and Flap Warning Silence Button	Push (Momentary)	— Silences gear audible warning signal (beeper).
7 Nosewheel Steering Button	Depress and Hold	— On ground— Engages nosewheel steering. Steering is controlled by movement of the rudder pedals. — In flight— May be used as microphone button.
8 Gear Alternate Release Reset Control (Ⓕ Front Cockpit)	OFF RESET	— Inoperative. — Resets landing gear to normal system. **CAUTION** Landing gear safety pins should be installed before using the reset control to reset the gear system on the ground to prevent possible gear collapse.
9 Nose Strut Switch (Ⓕ Front Cockpit)	EXTEND RETRACT	— Lengthens nose gear strut to "hiked" position. — Shortens nose gear strut to "dehike" position.

CAUTION

If handle is improperly stowed, not fully in and in vertical position, it may prevent gear normal retraction/extension and cause loss of nosewheel steering.

LANDING GEAR DOWNLOCK OVERRIDE

The landing gear downlock override button to the right of the landing gear lever (figure 1-50) enables the landing gear lever to be raised to the LG UP position while the aircraft is on the ground with the struts compressed. If the locking solenoid fails to release the landing gear lever from the LG DOWN position when the struts are extended, as after takeoff, the button can be pressed and held to allow the lever to be placed at LG UP.

NOSEWHEEL STEERING

The nosewheel steering system provides directional control and shimmy damping during ground operation. With the nosewheel steering button pressed and held, nosewheel steering is controlled by movement of the rudder pedals. Nosewheel steering is available when the aircraft weight is on the right main gear. When the nosewheel steering button is released, the system provides viscous shimmy damping capability. Damping is effected by use of hydraulic fluid trapped within the nosewheel steering actuator and is not dependent upon utility hydraulic system pressure.

WHEEL BRAKE SYSTEM

Each main wheel is equipped with a hydraulically operated multiple-disk power brake assembly. Brakes are operated by conventional toe-type brake pedals (rudder pedals) and use utility hydraulic system pressure to operate brake control valves. Proper brake dis operating clearances are automatically provided when the brake pedals are momentarily pressed hard while engines are running. Should the utility system fail, the brake valve acts as a brake master cyclinder, and brake pressure is proportional to the amount of foot pressure applied to the brake pedal. After utility system failure, unlimited brake applications are still available.

DRAG CHUTE SYSTEM

The drag chute system consists of a 15-foot ring-slot deceleration parachute, packed in a deployment bag and stowed in an air-cooled compartment at the base of the rudder, and a T-handle (Ⓕ both cockpits) to deploy the chute.

DRAG CHUTE HANDLE

The drag chute T-handle on the instrument panel (figures 1-9 thru 1-14) is mechanically connected to the drag chute release mechanism. To deploy the chute, the handle is pulled straight out (without turning) to the first stop (approximately 3-1/4 inches). Initial movement of the handle latches the drag chute to the aircraft. Further movement of the handle unlocks the compartment door latch, allowing the spring-loaded pilot chute to deploy and withdraw the drag chute into the airstream. The handle will lock in the deployed position. The drag chute can be jettisoned by turning the T-handle 90 degrees clockwise and pulling it out to the next stop (approximately an additional 3-1/4 inches). The handle is under spring tension during the final pull to jettison chute. When released, the handle will retract to the first stop. To stow, rotate the handle counterclockwise and push it in.

CAUTION

To avoid inadvertent jettisoning of the drag chute, ensure that handle is pulled to first stop and locked without rotation.

ARRESTING HOOK SYSTEM

The arresting hook system is an emergency system consisting of a retracted hook under the fuselage aft section and a button (Ⓕ both cockpits) (figure 1-9 thru 1-14) to electrically release and extend the hook for runway arrestment. The hook is held in the up position by a lock assembly. A ground safety pin is provided to prevent inadvertent actuation on the ground and must be removed before flight. The gear lever must be down for hook to extend. For extension, the uplock is released electrically by pushing the arresting hook button. The hook then extends by torsion bar spring force, which maintains a positive downward force on the hook while a self-contained hydraulic damping unit acts as a snubber to minimize hook bounce. Activation of the arresting hook button will illuminate the light in the button and will automatically dehike the nose gear strut, if hiked. See section V for authorized arrestment systems.

SPEED BRAKE SYSTEM

An electrically-controlled, hydraulically-actuated speed brake is located under the fuselage center section. The speed brake is powered by the utility hydraulic system and controlled by a three-position speed brake switch on the right throttle in each cockpit (figure 1-31). The variable speed brake has a full extension of 45° without a centerline (CL) store and 30° with a CL store. After release or jettison of CL store, full speed brake extension is obtained by cycling the speed brake switch. High airspeeds may prevent full extension. The speed brake and horizontal tail are mechanically interconnected to minimize trim change during speed brake operation.

SPEED BRAKE SYSTEM [Before T.O. 1F-5E-541]

Speed brake extension is limited to 25° with 275-gallon CL tank and will automatically extend to 45° after CL store release/jettison.

WARNING

If speed brake is out, the speed brake switch should be centered (OFF) before releasing any CL store to avoid large nose-down pitch changes resulting from automatic full extension of speed brake.

SPEED BRAKE OPERATION

Positioning the switch aft opens speed brake (out); forward position closes speed brake (in). The center (off) position neutralizes hydraulic pressure. Intermediate speed brake positions can be obtained by short intermittent actuation of the switch. For the open and intermediate speed brake positions, the switch (Ⓕ front cockpit) should be returned to center position after positioning speed brake. The speed brake switch in the Ⓕ rear cockpit is springloaded to the center position.

NOTE

- Ⓕ Actuation of the rear cockpit speed brake switch overrides front cockpit selection of speed brake. To prevent the possibility of speed brake creeping open after being closed from rear cockpit, cycle the front cockpit switch to the center and then to the forward position. After closing the speed brake from front cockpit, leave switch at forward position.
- Ⓕ To regain control of speed brake operation in the front cockpit, place the front cockpit speed brake switch in the center position, then actuate to obtain desired speed brake position.

WING FLAP SYSTEM

The wing flap system consists of leading edge and trailing edge flaps used for takeoff and landing, cruise, and maneuvering flight. Each flap surface is operated by an electrical actuator powered by an ac motor. The left and right leading edge flap actuators and the left and right trailing edge flap actuators are interconnected. Both the leading and trailing edge flaps are electrically interconnected and, in turn, are mechanically interconnected to the horizontal tail operating mechanism to minimize trim change automatically when the flaps are operated.

FLAP SYSTEM CONTROLS

The flap system provides the following settings: UP, cruise (CR), maneuver (M), and FULL. Flap settings are controlled by the flap thumb switch when the flap lever is at THUMB SW position. The flap lever can override the thumb switch to the EMER UP and FULL flap positions. A flap position indicator provides visual indication of setting.

FLAP SYSTEM CONTROLS Ⓕ

The front cockpit has a three-position thumb switch: M, CR, and UP. The rear cockpit thumb switch is spring-loaded to an unmarked center position, which transfers thumb switch control of flap settings to the front cockpit. Momentarily positioning rear cockpit thumb switch to M or UP overrides front cockpit thumb switch selection. The flaps will remain in the position selected by the rear cockpit thumb switch until another position is selected by the rear thumb switch or the front cockpit thumb switch is cycled to desired setting. However, holding the rear cockpit thumb switch in M or UP overrides any cycling or positioning of front cockpit thumb switch. Flap lever selection of either EMER UP or FULL in either cockpit overrides any thumb switch selection. A flap indicator on the instrument panel in both cockpits provides visual indications of flap settings.

NOTE

- Momentary power interruption [Before T.O. 1F-5F-505] to the front cockpit thumb switch effectively cycles the switch and will cause the flaps to move to the position selected in the front cockpit.
- For critical phases of flight, the front cockpit thumb switch should be positioned, if required, to reflect the flap position selected in the rear cockpit.

MANEUVERING FLAPS

In the maneuver setting, the flaps are automatically positioned by signals from the central air data computer (CADC). Above 550 KIAS or 0.95 mach, the CADC prevents extension of the flaps by the thumb switch or, if the flaps are extended, will initiate a steady audio warning signal. The audio warning may be silenced by retracting the flaps or pushing the warning silence button next to the gear lever. The flap position indicator and/or the audible signal will sound in the following conditions:

MANEUVERING FLAP CONDITION	Barber Pole	Audible Signal
Loss of CADC with maneuvering flaps selected	No	No
Exceeding 550 KIAS or 0.95 mach (whichever is less) with flaps extended	No	Yes
Flap setting not in agreement with control position	No	No
Electrical power removed	Yes	No
Flaps repositioning (in transit)	Yes	No

CAUTION

Ⓕ The audio warning may be masked by cockpit noise during low altitude, high speed flight.

Maneuvering flaps are used for takeoffs and landings and may be used for in-flight maneuvering. See figure 1-51 for controls, settings, indications, and autoshift speeds.

CRUISE FLAPS

In the cruise (CR) setting, the flaps are at 0°/8°, which provides improved fuel consumption and buffet control when the aircraft is flown at reduced speed for maximum endurance with stores. Maximum range for all configurations and maximum endurance for a clean aircraft is obtained with flaps up.

FLIGHT CONTROL SYSTEM

The flight control system consists of an all-movable horizontal tail, ailerons, rudder, and a stability augmenter system. All control surfaces are actuated by dual hydraulic actuators, one powered by the utility hydraulic system and the other by the flight control hydraulic system. If either hydraulic system malfunctions, hydraulic power to the flight control system will continue to be available. Artificial "feel" is built into the system, and electrical trim actuators change the relationship of the "feel" springs to the control stick. See figure 1-52 for location and function of all controls and indicators.

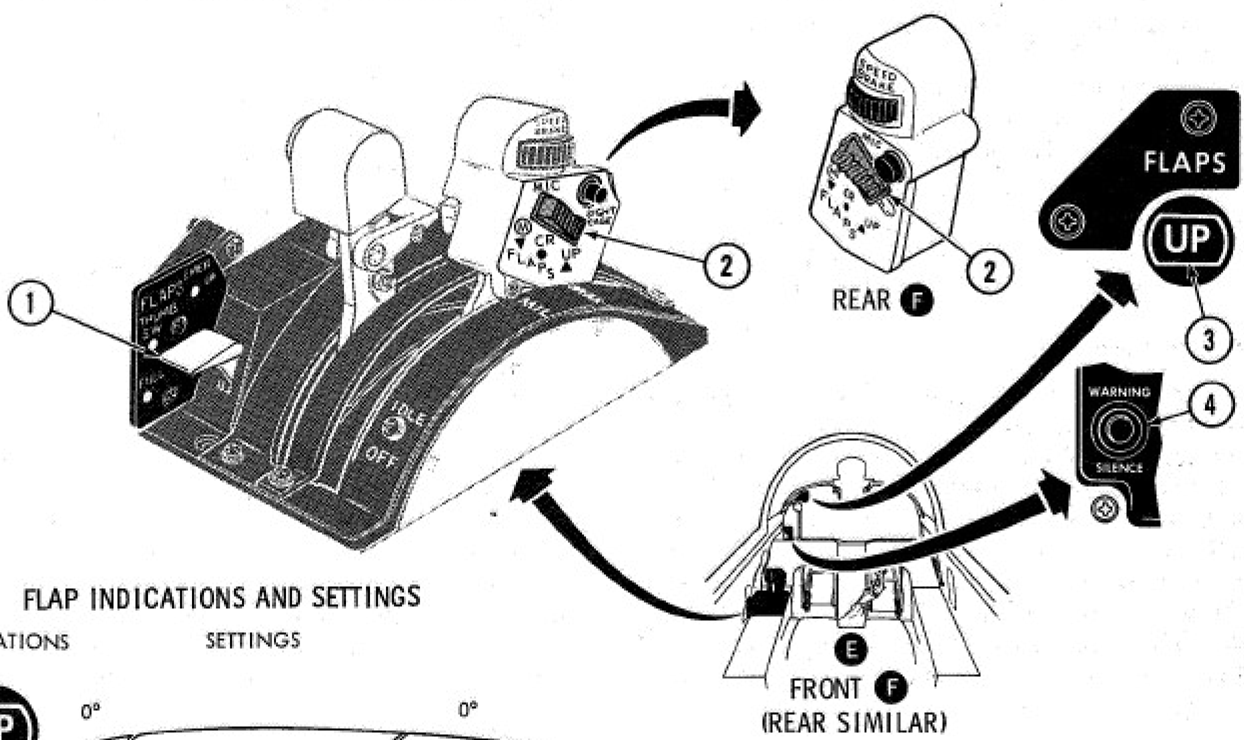
CONTROL STICK

The control stick incorporates a pitch and aileron trim button, missile/bomb/rocket button, gun trigger (Ⓕ inoperative in rear cockpit), dog-fight button, nosewheel steering button, and a pitch damper cutoff switch. The nosewheel steering button may be used as an alternate microphone button during flight, with landing gear up or down.

STABILITY AUGMENTER SYSTEM

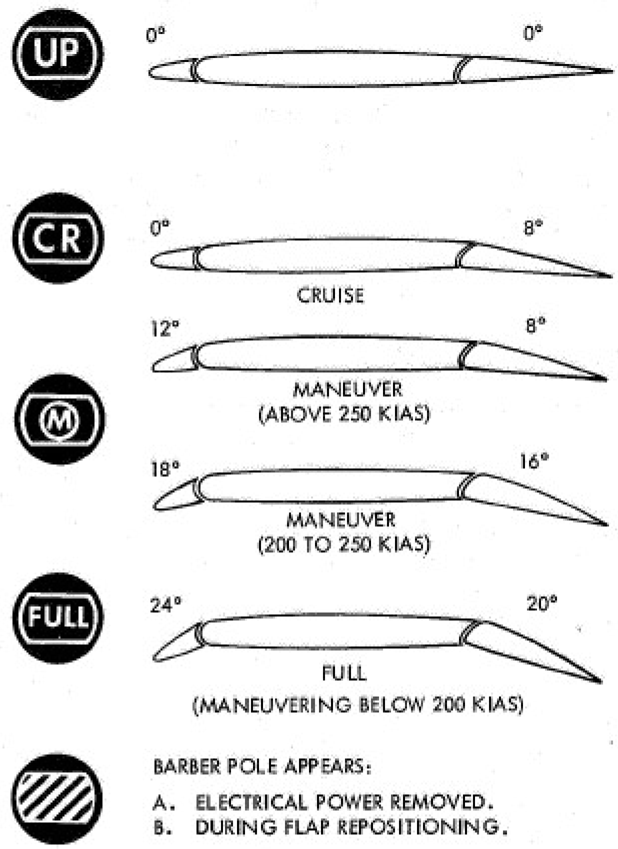
The stability augmenter system (SAS) automatically positions the horizontal tail and rudder to damp out pitch and yaw oscillations and also provides manual rudder trim. With yaw damper off, rudder trim is inoperative and returns to neutral. The system is controlled by pitch and yaw damper switches and a pitch damper cutoff switch. The damper switches are electromagnetically held in the engaged positions and are spring-loaded to the off positions; and will disengage automatically in case of certain system malfunctions or loss of ac power. The CADC senses airspeed and determines the amount of control surface movement required. The aircraft can be safely flown without augmentation throughout the entire flight envelope. However, augmentation improves handling characteristics and may be desirable for particular missions. The system can be disengaged at any time during flight and may be reengaged during flight provided the SAS limitations in section V are observed. See

WING FLAP SYSTEM CONTROLS/ INDICATOR (TYPICAL)

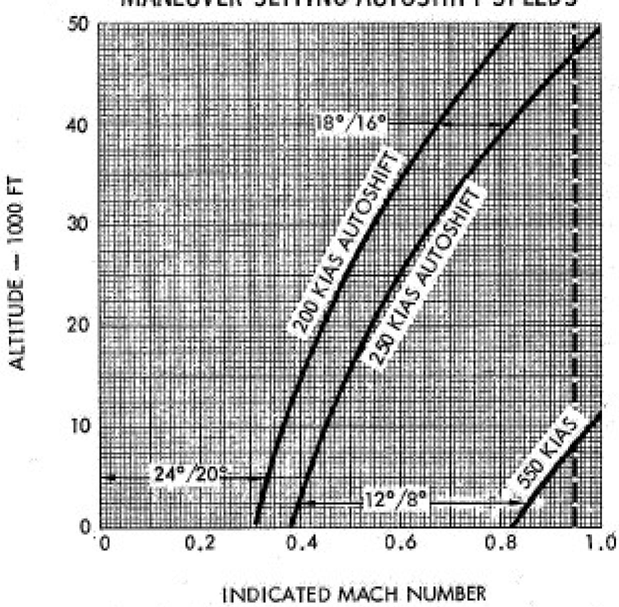


FLAP INDICATIONS AND SETTINGS

INDICATIONS SETTINGS



MANEUVER SETTING AUTOSHIFT SPEEDS



Note

WHEN REPOSITIONING FLAPS FROM UP TO FULL OR FULL TO UP, THE FLAPS INDICATOR WILL SHOW **M** MOMENTARILY AS FLAPS PASS THRU 12°/8° AND 18°/16° POSITIONS.

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Figure 1-51.

WING FLAP SYSTEM CONTROLS/INDICATOR (TYPICAL) (Figure 1-51)

CONTROLS/INDICATOR	FUNCTION	
1 Flap Lever	EMER UP	— Leading and trailing edge flaps fully retracted, overriding the flap thumb switch.
	THUMB SW	— Transfers flap control to flap thumb switch.
	FULL	— Leading and trailing edge flaps fully extended, overriding the flap thumb switch.
2 Flap Thumb Switch	UP	— Leading and trailing edge flaps fully retracted.
	CR	— Trailing edge flap at cruise position.
	M	— Leading and trailing edge flaps at maneuver setting.
	Unmarked Center Position (Ⓕ Rear Cockpit)	— Transfers thumb switch control of flaps to front cockpit.
3 Flaps Position Indicator	See figure 1-51 for flap indications vs flap position.	
4 Landing Gear And Flap Warning Silence Button	Push (Momentary)	— Silences flap audible warning signal (steady tone).

figure 1-52 for location and function of controls and indicator.

AILERON LIMITER

An aileron limiter, which is mechanically positioned by retraction of the landing gear, provides a spring stop which limits the aileron to one-half travel. To obtain full aileron travel of 35 degrees up and 25 degrees down, additional stick force must be applied to override the aileron spring stop. The aileron limiter is disengaged when the landing gear is in the extended position, allowing full aileron travel.

RUDDER TRAVEL

Maximum rudder deflection is 30 degrees either side of neutral with the landing gear extended or retracted; however, the amount of deflection during flight is a function of dynamic pressure force on the rudder surface and varies with airspeed and altitude.

HORIZONTAL TAIL TRAVEL

Maximum Ⓔ horizontal tail travel is 17 degrees up and 5 degrees down. Maximum Ⓕ horizontal tail travel is 20 degrees up and 5 degrees down.

FLIGHT CONTROL SYSTEM CONTROLS/INDICATORS (TYPICAL)

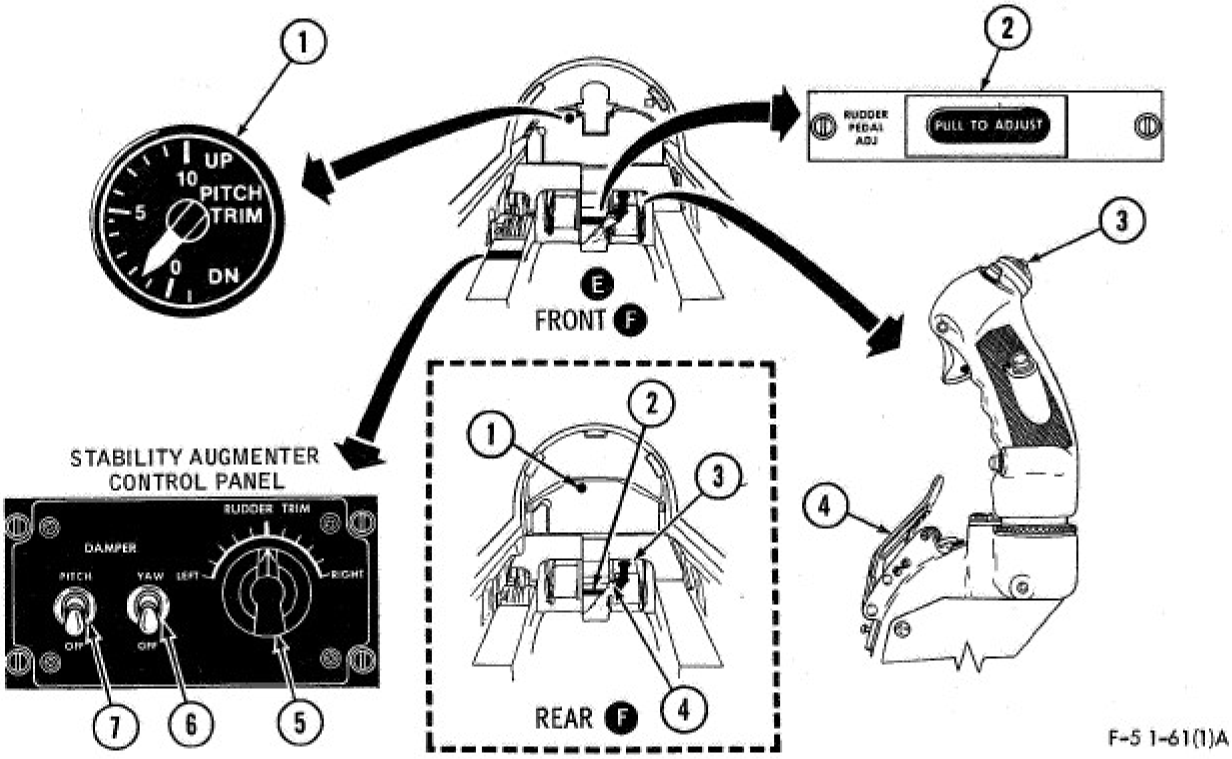


Figure 1-52.

FLIGHT CONTROL SYSTEM CONTROLS/INDICATORS (TYPICAL) (Figure 1-52)

CONTROLS/INDICATORS	FUNCTION
1 PITCH TRIM Indicator	Indicates trim position of the horizontal tail from –1 to 10 increments.
2 Rudder Pedal Adjust T-Handle	PULL — Allows rudder pedal to be adjusted to desired position. Stow — Locks rudder pedals in desired position. **CAUTION** Allowing handle to snap back may trip circuit breakers and cause the cable to kink and wear excessively.
3 Trim Button	Provides aileron trim in both directions and pitch trim from 10 increments nose-up trim to 1 increment nose-down trim.
4 Pitch Damper Cutoff Switch	SQUEEZE — Disengages the pitch damper.
5 Rudder Trim Knob	Provides rudder trim in 5 increments of trim either side of neutral. (Trim effective only when yaw damper switch is at YAW.)

FLIGHT CONTROL SYSTEM CONTROLS/INDICATORS (TYPICAL) (Figure 1-52) (Continued)

CONTROLS/INDICATORS	FUNCTION	
6 YAW DAMPER Switch	YAW	— Engages the yaw damper.
	OFF	— Disengages the yaw damper.
7 PITCH DAMPER Switch	PITCH	— Engages the pitch damper.
	OFF	— Disengages the pitch damper.

PITOT-STATIC SYSTEM

The pitot-static system supplies both impact and static air pressure to the CADC and the airspeed/mach indicator. The altimeter and vertical velocity indicator receive only static pressure from the system.

AAU-7A/A PRESSURE ALTIMETER

The AAU-7A/A is an aneroid altimeter which senses and indicates uncorrected pressure altitude based on static pressure inputs from the pitot-static system. A setting knob at the lower left of the instrument face adjusts the altimeter setting and altitude indications. The AAU-7A/A does not receive corrected altitude inputs from the CADC.

AAU-19/A ALTIMETER

The AAU-19/A altimeter (figures 1-9 thru 1-11) in its primary (servoed) operating mode indicates corrected pressure altitude. The altimeter also has a standby (STBY) mode of operation in which uncorrected static pressure altitude from the pitot-static system is displayed. In the servoed mode, corrected altitude is computed by the CADC. The STBY mode is automatically operative in the event of CADC failure. Once the STBY mode has taken over, the mode control lever on the lower right corner of the instrument must be moved to the RESET position to return the altimeter to the servoed mode.

AAU-34/A ALTIMETER

The AAU-34/A altimeter (figures 1-12 thru 1-14) indicates up to 80,000 feet, and is settable to sea level pressures from 28.10 to 31.00 inches of mercury. The primary (servoed) mode is indicated by the ELECT (electrical) position of the ELECT/PNEU (pneumatic) switch at the lower right of the dial face and the ELECT flag. The standby (backup) mode is indicated by the PNEU switch position and flag. Three drums indicate altitude in 10,000, 1000, and 100-foot increments in a five-digit numeric display in the face of the instrument. A single multi-turn pointer rotates clockwise around the dial, which is graduated from 0 to 1000 feet in 50 and 100-foot increments.

AIRSPEED/MACH INDICATOR

The AVU-8 airspeed/mach indicator (figures 1-9 thru 1-14) indicates airspeed in knots from 80 to 850 and in mach number from 0.5 to 2.2 and is driven by the pitot-static system. The indicator includes a maximum allowable airspeed pointer (red) and an index setting pointer. The setting pointer is controlled by a knob in the lower right corner of the instrument.

CENTRAL AIR DATA COMPUTER (CADC)

The CADC converts raw air data inputs into computed outputs. See figure 1-53 for CADC functions. The CADC is equipped with a failure monitoring system which continually monitors the computing functions. Should a failure occur, the AIR DATA COMPUTER light on the caution light panel will come on. However, failures within the pitot-static system may cause erroneous inputs to the CADC that are not indicated by caution light illumination.

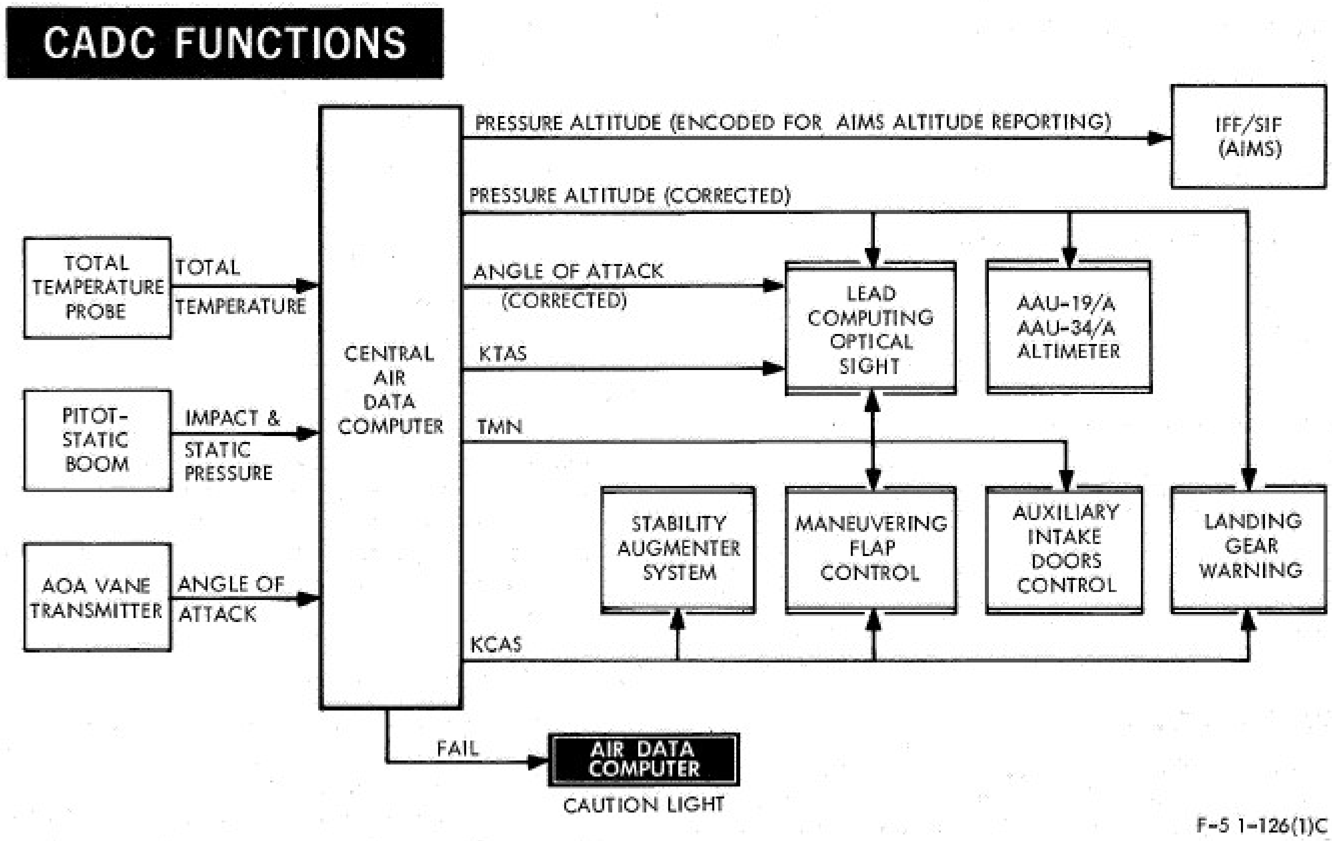


Figure 1-53.

ANGLE-OF-ATTACK SYSTEM

The angle-of-attack (AOA) system consists of a vane transmitter mounted on the fuselage and AOA indicator and indexer in the cockpit (Ⓕ both cockpits). With landing gear down, the system automatically provides angle-of-attack information thru displays on the AOA indicator and indexer. With landing gear up, AOA information is displayed only on the indicator. AOA transmitter information is also provided to the CADC for use by the optical sight system.

AOA INDICATOR

The AOA indicator is calibrated in units from 0 to 30 and operates in all phases of flight. The on-speed index on the face of the indicator is set at approximately 3-o'clock position (15.8 units) (figure 1-54), which is the optimum angle of attack for normal landing approaches with gear and flaps down. Each Ⓕ indicator has a maximum rate-of-turn index set at 21 units. When electrical power is removed from the AOA system, an OFF flag will appear on the face of the AOA indicator.

AOA INDEXER

The AOA indexer is operative only when the landing gear is down to provide a heads-up display (figure 1-54) of AOA information in the form of three lighted symbols. The three lighted symbols include a RED chevron (upper) low-speed symbol, a GREEN (center) circle on-speed symbol, and a YELLOW chevron (bottom) high-speed symbol.

AOA MANEUVER MODE SWITCH Ⓕ

Each cockpit has an AOA maneuver mode switch on the left trim panel (figures 1-22 thru 1-26), placarded ON and OFF and springloaded to the center (neutral) position. Momentarily placing either switch to the ON position, with the landing gear up, will activate both front and rear indexer lights. The indexer lights can be turned off by moving either switch from the center position to the OFF position while the gear is up. Placing the gear down overrides the maneuver mode switches on indexer operation and landing approach AOA is displayed continuously by the indexers.

NOTE

- Due to time delay in system, aircraft may have passed thru maximum rate-of-turn AOA before indexers and indicators display this information. However, accurate information is displayed when maximum rate-of-turn AOA is entered with smooth, not too rapid, application of flight controls.
- If the indexer lights are on when the gear is moved from the up to the down position, they may flash on and off until approach information is displayed.

ATTITUDE AND HEADING REFERENCE SYSTEM (AHRS)

The AHRS (figures 1-55 and 1-56) consists of an attitude sensing and indicating subsystem and a heading and navigation subsystem, a rate switching gyro, and a power switch (located behind headrest, Ⓕ rear cockpit headrest), which control and coordinate the functioning and indications of the subsystems.

ATTITUDE INDICATOR

The ARU-20/A attitude indicator (AI) (Ⓕ both cockpits) (figure 1-55) is gyro-stabilized to show aircraft pitch and roll attitude. The attitude sphere is stabilized by the displacement gyro (two-gyro platform) powered by the left ac bus and the dc bus. The AHRS rate gyro balances electrical inputs to the displacement gyros so that the attitude sphere maintains position thru all aircraft maneuvering. The AI can be tumbled by power interruptions which cause an OFF flag to appear in the lower left of the indicator face. If power failure occurs in any flight condition other than straight and level, the AI may erect to a false vertical when power is returned. The FAST-ERECT switch on the instrument panel next to the AI (Ⓕ front cockpit) is provided to expedite gyro erection. When the switch is pressed and held the attitude sphere and the horizon bar on the radar indicator, when turned on, will erect. Inflight erection should be accomplished in straight and level flight. The attitude sensing subsystem provides pitch and roll signals to the fire control radar and roll signals to the lead computing optical sight.

ATTITUDE DIRECTOR INDICATOR [T.O. 1F-5E-611]

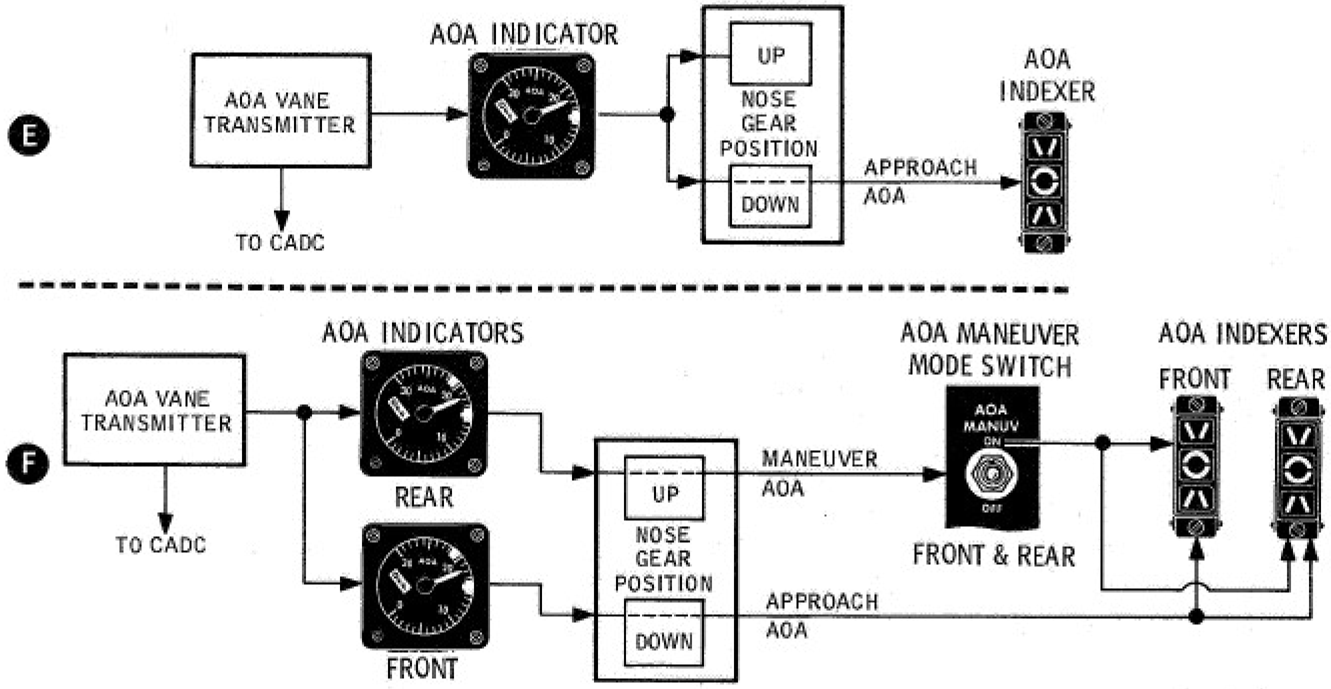
The attitude director indicator (ADI) (figure 1-55) is gyro-stabilized to show aircraft pitch and roll attitude. The attitude sphere is continuously stabilized to maintain position thru all aircraft maneuvering. The rate gyro balances electrical inputs from the displacement gyros to provide

ANGLE-OF-ATTACK SYSTEM/DISPLAYS

Note

OFF FLAG APPEARS ONLY WHEN SYSTEM IS DEENERGIZED.

ANGLE-OF-ATTACK SYSTEM



ANGLE-OF-ATTACK DISPLAYS (GEAR AND FLAPS DOWN) (F IDENTICAL)

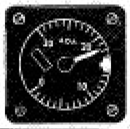
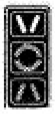
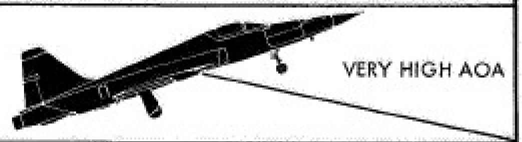
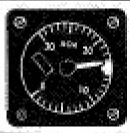
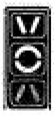
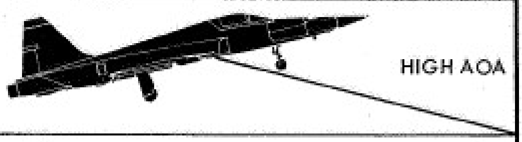
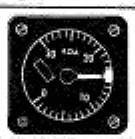
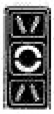
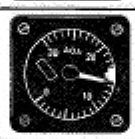
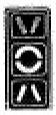
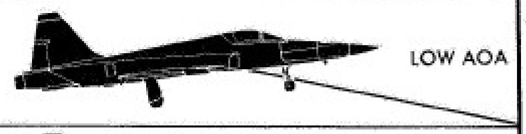
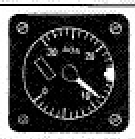
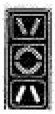
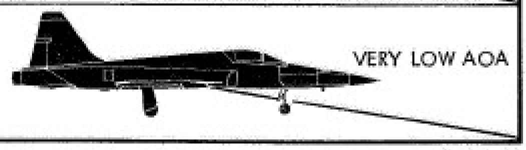
INDICATOR	INDEXER	AIRSPEED	ATTITUDE
	 (RED)	SLOW	 VERY HIGH AOA
	 (RED) (GREEN)	SLIGHTLY SLOW	 HIGH AOA
	 (GREEN)	ON SPEED	 OPTIMUM AOA
	 (GREEN) (YELLOW)	SLIGHTLY FAST	 LOW AOA
	 (YELLOW)	FAST	 VERY LOW AOA

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Figure 1-54.

ATTITUDE REFERENCE CONTROLS/INDICATORS

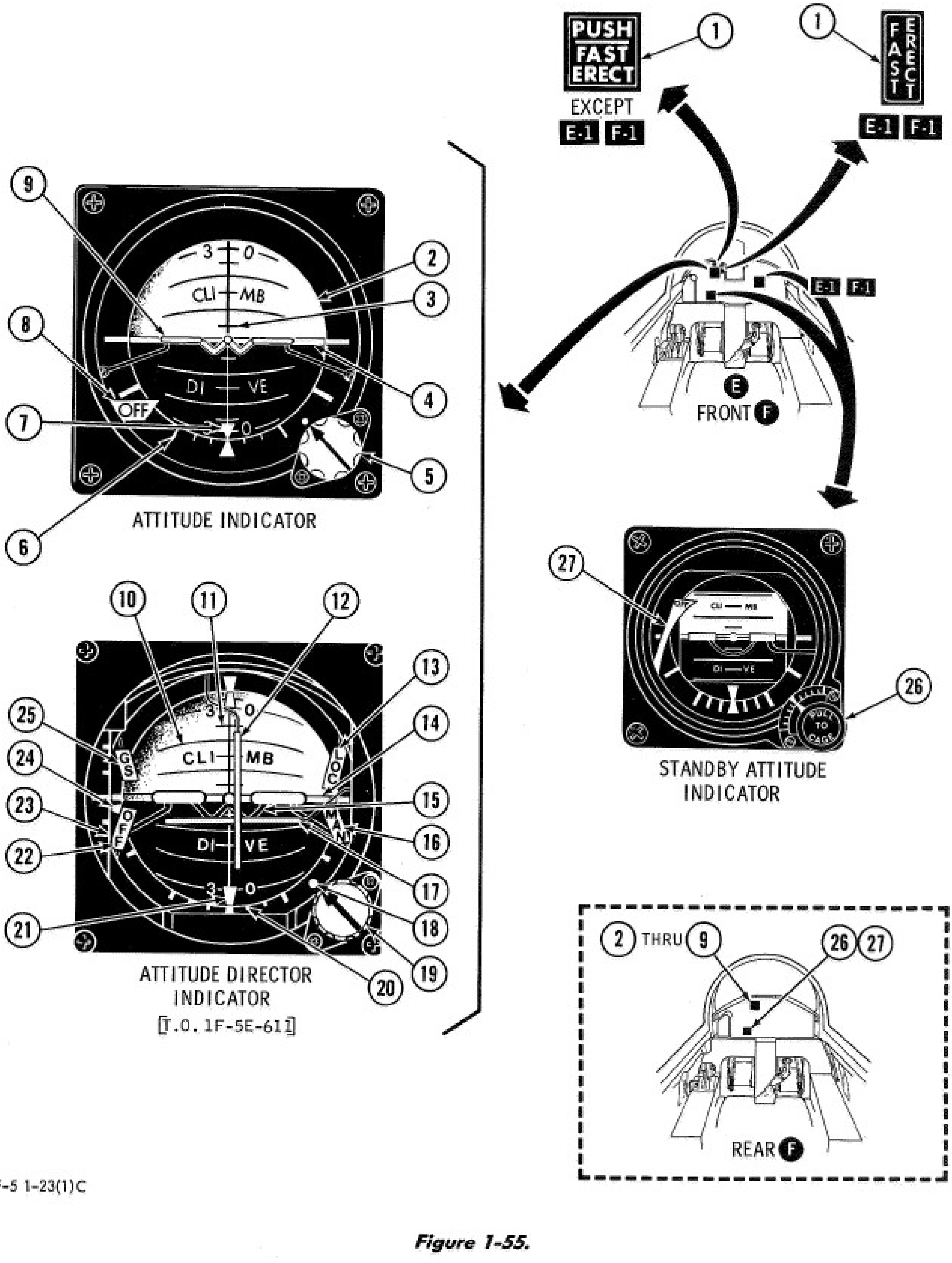

Figure 1-55.

ATTITUDE REFERENCE CONTROLS/INDICATORS (Figure 1-55)

CONTROLS/INDICATORS	FUNCTION
1 PUSH FAST-ERECT Switch (FAST ERECT [E-1] [F-1])	Push and Hold — Provides fast erection of the AI (ADI [T.O. 1F-5E-611]) at a minimum rate of 15 degrees per minute.
ATTITUDE INDICATOR (2 thru 9) 2 Attitude Sphere	Position relative to miniature aircraft and horizon bar shows pitch and roll attitude.
3 Pitch Reference Scale	Measures pitch attitude in 5-degree increments.
4 Horizon Bar	Indicates horizon.
5 Pitch Trim Knob	Adjusts position of horizon bar relative to miniature aircraft.
6 Bank Scale	Reference scale for measurement of bank angle in 10-degree increments.
7 Bank Pointer	Indicates bank angle in conjunction with bank scale.
8 Attitude Warning Flag	OFF — In view if electrical power to instrument is interrupted or has failed.
9 Miniature Aircraft	Fixed reference point to indicate attitude of aircraft.
ATTITUDE DIRECTOR INDICATOR (10 thru 25) 10 Attitude Sphere	Position relative to miniature aircraft and horizon bar shows pitch and roll attitude.
11 Pitch Reference Scale	Measures pitch attitude in 5-degree increments.
12 Bank Steering Bar	In ILS mode, indicates direction of deviation from the localizer course.
13 Localizer Warning Flag	LOC — Indicates ILS localizer course indications unreliable.
14 Horizon Bar	Indicates horizon.
15 Miniature Aircraft	Fixed reference point to indicate aircraft attitude.
16 Manual Mode Flag	MAN — In view when electrical power is off. Out of view when power is on.
17 Pitch Steering Bar	In ILS mode, indicates direction of deviation from glide-path.
18 Pitch Trim Index	Index for zero pitch trim.
19 Pitch Trim Knob	Adjusts position of horizon bar relative to miniature aircraft.

ATTITUDE REFERENCE CONTROLS/INDICATORS (Figure 1-55) (Continued)

CONTROLS/INDICATORS	FUNCTION	
20 Bank Scale	Reference scale for measurement of bank angle in 10-degree increments.	
21 Bank Pointer	Indicates bank angle in conjunction with bank scale.	
22 Attitude Warning Flag	OFF	— In view, if electrical power to the instrument is interrupted or has failed, and during fast erect cycle.
23 Glide-Slope Scale	Indicates angular vertical displacement above or below glide slope. Each mark indicates 0.25 degree.	
24 Glide-Slope Pointer	Indicates amount and direction of vertical deviation from glide slope.	
25 Glide-Slope Warning Flag	GS	— In view if glide-slope indications unreliable.
STANDBY ATTITUDE INDICATOR (26 and 27) 26 PULL TO CAGE/Pitch Trim Knob	Pull and Release	— Permits initial erection of gyro. Gyro will erect to true vertical within 3 minutes.
	In	— Rotation of knob permits adjusting position of horizon bar relative to miniature aircraft.
27 OFF Flag	In view when electrical power is removed and when caging trim knob is pulled out.	

sphere stabilization. The ADI can be tumbled by power interruptions which cause an OFF flag to appear at the lower left of the indicator face. If failure occurs in any condition other than straight and level flight, the ADI may erect to a false vertical when power is returned. The ADI also includes pitch and bank steering bars and localizer (LOC) and glidescope (GS) warning flags. The pitch and bank steering bars function to provide deviation indications when making instrument landing system (ILS) approaches. The LOC and GS warning flags provide warning of failures of the localizer or glidescope functions of the ILS. The ADI is powered by the left ac bus.

HEADING AND NAVIGATION SUBSYSTEM

The heading and navigation subsystem consists of the AQU-10/A navigation indicator [Before T.O. 1F-5-729] or the AQU-13/A or -13A/A horizontal situation indicator (HSI), a compass switch, and a magnetic azimuth detector and compensator.

HEADING REFERENCE CONTROLS/INDICATORS

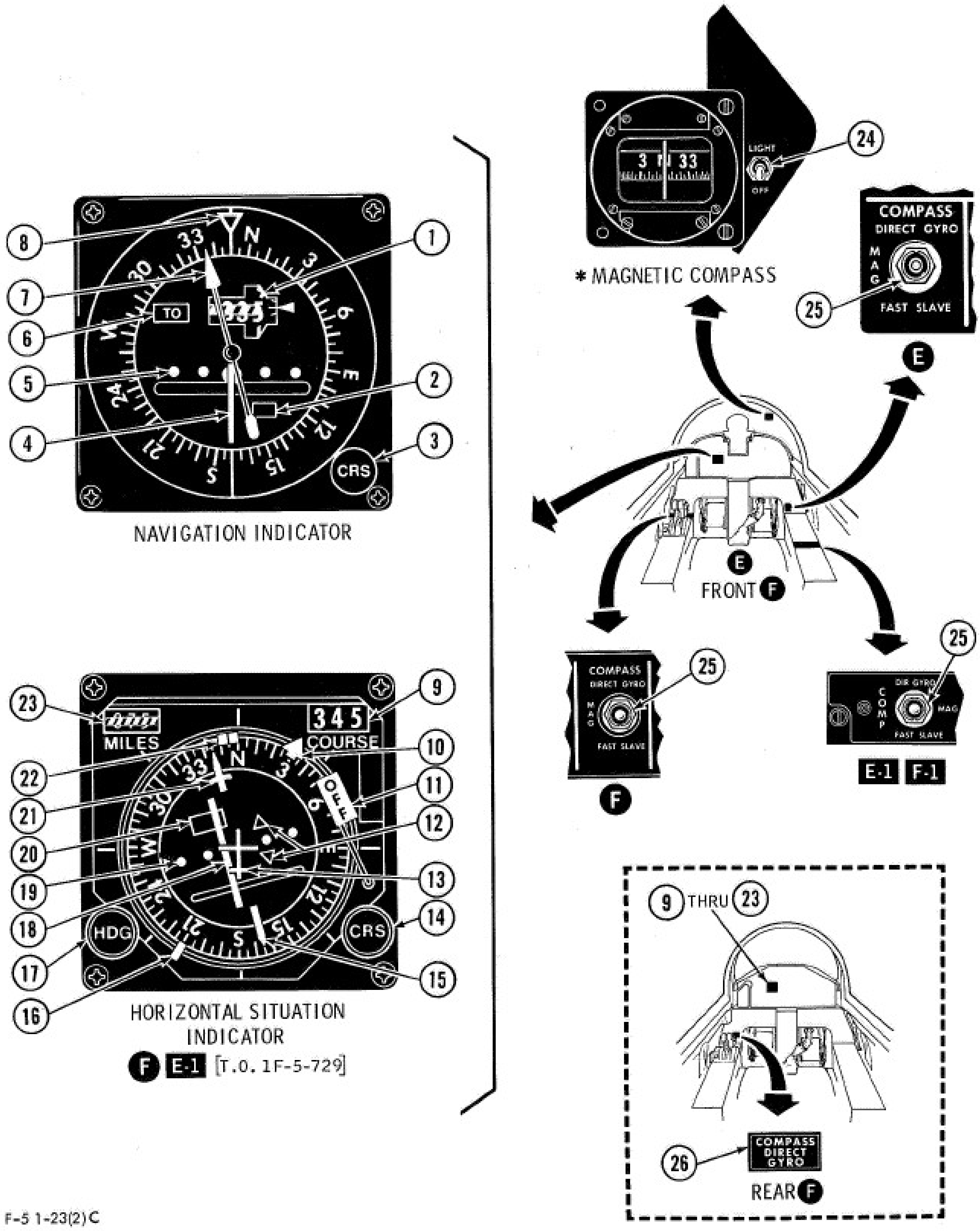

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Figure 1-56.

HEADING REFERENCE CONTROLS/INDICATORS (Figure 1-56)

CONTROLS/INDICATORS	FUNCTION
AQU-10/A NAVIGATION INDICATOR (1 thru 8)	
1 Range Indicator and Warning Flag	Numeric Display — Shows slant range (nm) to or from selected TACAN station. Barber Pole Display — Selected station is out of range, electrical power failure, instrument malfunction, or ADF selected.
2 Deviation/DF Window	Blank — Indicates normal operation and valid indications in TACAN mode. DEV — Indicates invalid indication, loss of power, or instrument malfunction in TACAN mode. In relative bearing the Deviation/DF window shows the DEV. DF — Indicates ADF mode.
3 CRS (Course Set Knob)	Positions course marker to indicate course to or from selected TACAN station.
4 Course Deviation Indicator (CDI)	Left and right movement of vertical bar along course deviation indicates position relative to on-course.
5 Course Deviation Scale	Indicates position left or right of selected course. Dots are positioned at 5 and 10 degrees left and right of on-course.
6 To/From Indicator	Indicates whether the course selected is to or from the station.
7 Bearing Pointer	Indicates magnetic bearing to selected TACAN station or UHF/ADF transmitter.
8 Course Marker	Indicates selected course; manually set by rotating CRS set knob in TACAN or ADF modes.
AQU-13/A or -13A/A HORIZONTAL SITUATION INDICATOR HSI (9 thru 23)	
9 Course Window	Displays course selected by CRS set knob.
10 Bearing Pointer (Head)	Indicates magnetic bearing to selected TACAN station or UHF/ADF transmitter.
11 OFF Flag	OFF — Display occurs only when electrical power to the instrument is interrupted or has failed.
12 TO/FROM Indicator (Triangular Windows)	Position of white triangle indicates whether selected course is to or from the station: If same side as course arrow head — TO; if same side as course arrow tail — FROM.

HEADING REFERENCE CONTROLS/INDICATORS (Figure 1-56) (Continued)

CONTROLS/INDICATORS	FUNCTION
13 Aircraft Symbol	Represents aircraft position and direction of movement relative to selected course.
14 CRS (Course Set Knob)	Positions course arrow. Course in degrees appears in course selector window.
15 Course Arrow (Tail)	Indicates reciprocal of selected course.
16 Bearing Pointer (Tail)	Indicates reciprocal of selected magnetic bearing.
17 HDG (Heading Set Knob)	Positions heading marker in all modes.
18 Course Deviation Indicator (CDI) (Center section of course arrow)	Indicates amount and direction of deviation from selected TACAN course.
19 Course Deviation Scale	Indicates position left or right of selected course. Each dot indicates course deviation of 5 degrees.
20 Deviation/DF Window	Blank — Indicates normal operation and valid indications in TACAN mode. Red Flag — Indicates invalid indications in TACAN mode, loss of electrical power, or instrument malfunction. DF — Indicates ADF mode operation.
21 Course Arrow (Head)	Indicates selected course; manually set by rotating CRS set knob.
22 Heading Marker	Indicates desired heading when manually set. Once set, the marker remains fixed relative to card.
23 Range Indicator & Warning Flag	Numeric Display — Shows slant range (nm) to or from selected TACAN station. Barber Pole Display — Selected station is out of range, electrical power failure, instrument malfunction, or ADF selected.
MAGNETIC COMPASS (24)	
24 LIGHT Switch	LIGHT — Turns on magnetic compass light. OFF — Turns off light.

HEADING REFERENCE CONTROLS/INDICATORS (Figure 1-56) (Continued)

CONTROLS/INDICATORS	FUNCTION	
25 COMPASS Switch (Ⓕ front cockpit) ([E-1] [F-1] COMP)	DIRECT GYRO ([E-1] [F-1] DIR GYRO)	— The compass card maintains orientation to the last magnetic north azimuth. Magnetic sensing is not available and heading displayed is based solely on directional stability.
	MAG	— (Normal operation)— Switching from DIRECT GYRO to MAG automatically fast slaves the compass card to indicate the correct magnetic heading. The card will remain oriented to magnetic north.
	FAST SLAVE	— Momentarily placing compass switch at FAST SLAVE erects the compass card to magnetic north within 25 seconds. **NOTE** The aircraft should be maintained in straight and level, unaccelerated flight for at least 30 seconds whenever using FAST SLAVE, or returning to MAG from DIRECT GYRO, or after ac power interruption. Wait 2 minutes between consecutive fast slave cycle attempts.
26 COMPASS DIRECT GYRO light (Ⓕ rear cockpit)	On	— Indicates compass switch in front cockpit is in DIRECT GYRO position.

Navigation Indicator or HSI

The navigation indicator [Before T.O. 1F-5-729] (figure 1-56) consists of a compass card graduated in 5-degree increments, a bearing pointer, upper and lower lubber lines, a course marker, a range window, a TO/FROM window, a Deviation/DF window, a course deviation indicator and scale and a course setting knob placarded CRS. The HSI contains basically the same components as the navigation indicator except for the course marker. In addition, the HSI (figure 1-56) contains a course arrow, heading marker, aircraft symbol, heading set knob, course window, and OFF flag. The AQU-13A/A has grey heading and course setting knobs. Operation and function of controls and indicators is identical to the AQU-13/A HSI.

Heading Information

With the compass switch at MAG, the magnetic heading of the aircraft is displayed under the upper lubber line, and the reciprocal heading is displayed under the lower lubber line. When the compass switch is in the DIRECT GYRO position, the heading displayed becomes a random heading. If DIRECT GYRO is selected with the correct magnetic heading displayed at the time of selection, the heading will probably remain close to the correct magnetic heading, as the gyro has a very slow random drift rate. If DIRECT GYRO is selected when the compass card is not properly slaved to magnetic north, the compass card will be stabilized but will not indicate proper magnetic heading. In this case, the magnetic compass must be used for correct magnetic heading. When the course arrow is set, it will remain aligned (parallel) with the radial or localizer course selected, providing the compass card is slaved to magnetic north.

The bearing pointer indicates correct magnetic bearing to a selected TACAN station when the compass card is functioning in the MAG mode. If the compass card is not aligned with magnetic north, which is possible when in the DIRECT GYRO mode, the bearing pointer will still indicate magnetic bearing to a selected TACAN station.

The bearing pointer will not indicate proper relative bearing if the compass card is not slaved to magnetic north. With bearing pointer or compass malfunctions, the CDI may be used to find magnetic headings to a TACAN station; for this use, center the CDI with a "TO" indication and fly the course in the course set window, using the standby compass.

CAUTION

With bearing pointer or compass malfunction, using the CDI to determine the magnetic course to a TACAN station should be attempted only as a last resort if unable to confirm position by radar.

Aircraft Symbol (AQU-13/A or -13A/A)

The aircraft symbol is presented at the center of the HSI and is fixed relative to the instrument. Comparison of the aircraft symbol with the compass card, course arrow, course deviation indicator, and heading marker will give a pictorial view of the angular relationship between the aircraft and the displayed navigational information.

TACAN and UHF/ADF Operation

When a TACAN channel is selected and MAG compass mode selected, the head of the bearing pointer will indicate the magnetic bearing to selected station and the range indicator window will show slant range distance to the station. When the course to the station has been selected with the course set knob, a white triangle (HSI) will appear on the same side as head of course arrow (indicating "TO"), the course deviation indicator (CDI) will display aircraft position relative to the selected course, and the Deviation/DF window will be blank. The CDI represents the selected TACAN radial. When ADF is selected, the bearing pointer indicates relative bearing to selected ground or airborne station. In this mode, the Deviation/DF window shows "DF", the CDI centers, and the range indicator warning flag drops. The TO/FROM in the AQU-10/A is indicated by the letters TO/FROM and function identical to the white triangles in the HSI.

STANDBY INSTRUMENTS

The standby instruments are the standby attitude indicator and the standby (magnetic) compass. These instruments function to provide backup attitude and heading, respectively, in the event of primary instrument failure.

Standby Attitude Indicator (ARU-32/A)

The standby attitude indicator (figure 1-55) is a self-contained indicator that provides a visual indication of the bank and pitch of the aircraft and should be used when the ARU-20/A attitude indicator or AHRS fails. The pitch limits are 92 degrees in climb, 78 degrees in dive, and the roll capability is a full 360 degrees. A dc-powered constant frequency inverter supplies ac power to the indicator and will provide attitude information after ac power failure [T.O. 1F-5E-586]. On unmodified aircraft, the indicator is powered by the right ac bus. When power is interrupted or the indicator is caged, the OFF warning flag appears on the face of the indicator. The indicator provides approximately 9 minutes of useful attitude information after power failure. The standby attitude indicator should be caged and set if required, following engine start, and left uncaged for the remainder of the flight. The instrument requires approximately 3 minutes to erect to true vertical after power is applied to the system.

WARNING

The indicator may precess following sustained acceleration or deceleration periods and may tumble during maneuvering flight near the vertical.

CAUTION

Avoid snap-releasing the cage and trim knob after setting to prevent damage to the instrument.

Standby Attitude Indicator (ARU-42/A-1)

The standby attitude indicator (figure 1-55) (Ⓕ both cockpits) is a self-contained indicator that provides a visual indication of the bank and pitch of the aircraft and should be used when the ARU-20/A attitude indicator or AHRS fails. Pitch limits are 92 degrees in climb, 78 degrees in dive, and roll capability is a full 360 degrees. The indicator is powered by 28-volt dc. When power is interrupted or the indicator is caged, the OFF warning flag will appear on the face of indicator. The indicator provides approximately 9 minutes of useful attitude information after power failure. The standby attitude indicator should be caged and set if required, following engine start, and left uncaged for remainder of flight. The instrument requires approximately 3 minutes to erect to true vertical after power is applied to indicator.

WARNING

The indicator may precess following sustained acceleration or deceleration periods and may tumble during maneuvering flight near the vertical.

CAUTION

Avoid snap-releasing the cage and trim knob after setting to prevent damage to the instrument.

Magnetic Compass

A magnetic (standby) compass on the upper right windshield frame (figure 1-56) (Ⓕ front cockpit only) is provided for use if the primary navigation systems fail. Illumination of the compass is controlled by a switch on the compass mount when the flight instrument light control knob on the lighting control panel is turned on. Compass correction cards are located in the holders mounted on the right interior trim panel of the cockpit (figures 1-3 thru 1-8).

COMMUNICATIONS AND NAVIGATION EQUIPMENT

The communications and navigation equipment are listed in figure 1-57. See figure 1-38 for electrical power requirements.

INTERCOMMUNICATIONS SYSTEM

The intercom system provides headset amplification for the UHF radio, the radio-navigation systems, maneuvering flaps and landing gear audio warning signals, the AIM-9 missile tones, cockpit-to-ground crew, and cockpit-to-cockpit communications.

CONTROL TRANSFER (COMM/NAV) Ⓕ

The COMM/NAV control transfer system allows transfer of cockpit operating control of either or both the UHF and navigation radio sets. The system consists of a UHF radio transfer switch and navigation transfer switch in the front cockpit and a UHF and navigation override switch in the rear cockpit. See figure 1-58 sheets 1 and 2 for location and function of controls.

UHF RADIO AN/ARC-150

The ARC-150 UHF radio (figure 1-58 sheet 1) provides two-way voice or tone communication at line-of-sight range. An interface with an AN/ARA-50 UHF/ADF provides direction-finding capability. Twenty UHF frequencies may be preset and selected by the preset channel selector control. The system includes a transceiver, a control panel (Ⓕ both cockpits), an antenna selector switch (Ⓕ front cockpit), and upper and lower antennas. A total of 7000 frequencies, spaced 25 kilohertz (0.025 megahertz) apart, may be dialed by using the manual frequency selector knobs and windows. The right window contains a basic digit 0 thru 9, and at the 0, 2, 5, and 7 digits an additional miniature digit will appear in the upper right corner of the window, as follows: 0^0, 2^5, 5^0, 7^5. See figure 1-58 sheet 1 for location and function of controls (Ⓕ front cockpit) indicators.

UHF RADIO AN/ARC-164

The ARC-164 UHF radio operates in the same manner as the ARC-150. See figure 1-58, sheet 1 and 2 for location and function of controls and indicators.

CAUTION

Do not key ARC-150 or ARC-164 transmitter while changing frequencies; damage to the transmitter will result.

COMMUNICATION / NAVIGATION EQUIPMENT

TYPE	DESIGNATION	USE	OPERATOR	RANGE	CONTROL LOCATION
INTERCOM	AN/AIC-18 AN/AIC-25	Crew intercommunication; flight crew and ground personnel intercommunication when aircraft is parked.	(E) Pilot. (F) Both crewmembers.	Cockpit(s) and exterior when interphone receptacle is used.	(E) None. (F) Pedestal – both cockpits.
UHF RADIO	AN/ARC-150 AN/ARC-164	Air-to-air and air-to-ground communication.	(E) Pilot. (F) Both crewmembers.	Line of sight.	(E) Pedestal. (F) Pedestal – both cockpits.
TACAN	AN/ARN-65 AN/ARN-84 AN/ARN-118	Bearing and range information. Reception of coded identification signals.	(E) Pilot. (F) Both crewmembers.	Bearing and DME range 200 NM line of sight. (ARN-84 and ARN-118 air-to-air DME range 250 NM).	(E) Pedestal. (F) Pedestal – both cockpits.
(E) VOR/ILS (LOCALIZER, GLIDE-SLOPE, MARKER BEACON) *	AN/ARN-127	VOR bearing and course information. Localizer course and glide-slope guidance. Marker beacon light identification reception.	Pilot	VOR - Line of sight 130 nm. Localizer course - 18 nm within 10° of centerline. Glide-slope-10nm. Marker beacon-vertical.	Right console and pedestal.
UHF/ADF	AN/ARA-50	Bearing information to ground or airborne UHF station.	(E) Pilot. (F) Both crewmembers.	Line of sight.	(E) Pedestal. (F) Pedestal – both cockpits.
IFF/SIF	AN/APX-72 AN/APX-101	Automatic coded replies to ground interrogation for aircraft identification and air traffic control.	(E) Pilot. (F) Front cockpit crewmember.	Line of sight.	(E) Right console. (F) Right console – both cockpits.
RADAR TRANSPONDER (SKYSPOT)	SST-181X	Automatic radar identification of aircraft for tracking by ground radar.	(E) Pilot. (F) Front cockpit crewmember.	Line of sight.	(E) Right vertical panel. (F) Left console – front cockpit.
(F) CONTROL TRANSFER SYSTEM	———	Enables either cockpit to control operation of communication/navigation equipment. Rear cockpit has override capability.	Both crewmembers.	Intercockpit.	Right console – front cockpit. Left vertical – rear cockpit (override).

ANTENNA LOCATIONS

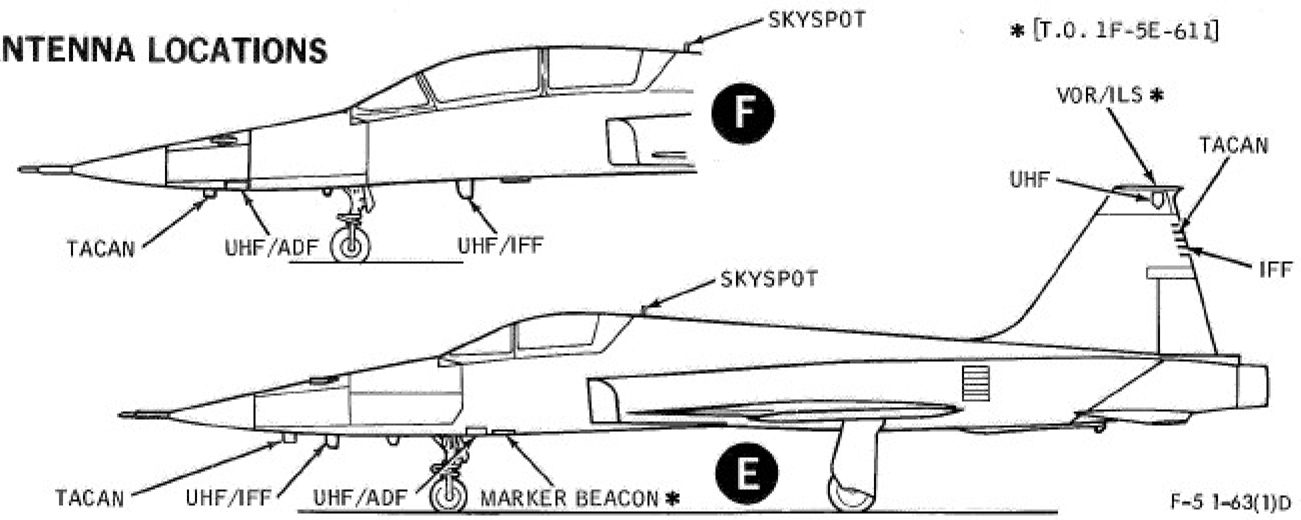

Figure 1-57.

COMMUNICATIONS CONTROLS (TYPICAL) EXCEPT E-1 F-1

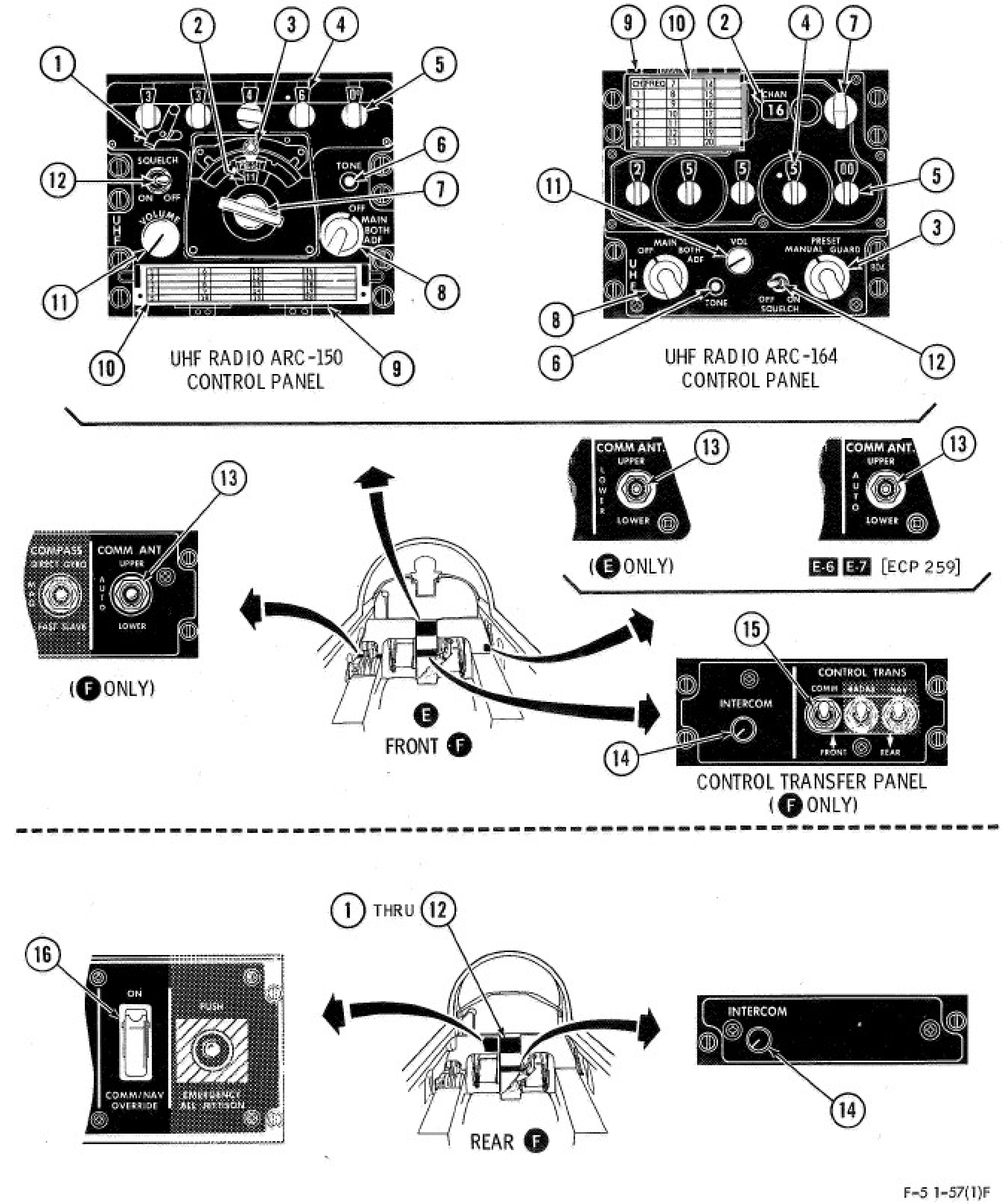

Figure 1-58 (Sheet 1).

COMMUNICATIONS CONTROLS

E-1 F-1

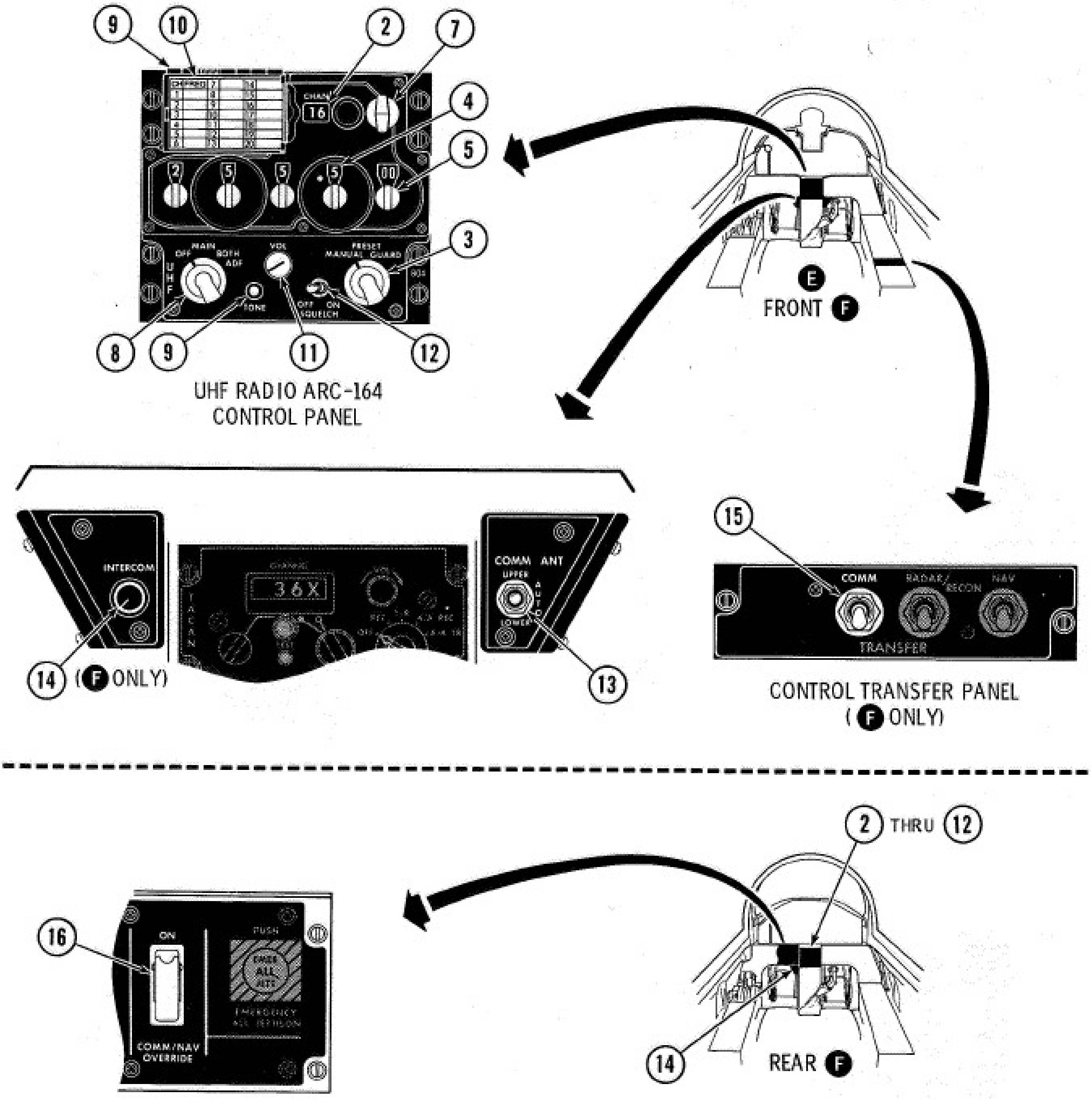

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Figure 1-58 (Sheet 2).

COMMUNICATION CONTROLS (Figure 1-58)

CONTROLS	FUNCTION
1 Manual Dial Cover Release Lever (ARC-150 only)	Covers or uncovers the frequency numbers in windows above the manual frequency selector knobs.
2 Preset Channel Indicator	Displays the frequency of selected preset channel.
3 Frequency Selector Mode	MANUAL — UHF frequency is manually selected by setting the five frequency select knobs. PRESET — Permits selection of one of the 20 preset frequencies. GUARD — Receiver and transmitter are tuned to 243.000 MHz (Military guard).
4 Manual Frequency Selector Windows	Five windows, displays discrete frequency selected with frequency selector knobs.
5 Manual Frequency Selector Knobs	Five knobs, to dial discrete UHF frequencies.
6 TONE Transmit Switch	Push and Hold — Transmits a 1020 cps tone on the selected frequency.
7 Preset Channel Selector Control	Selects one of the 20 preset UHF frequencies.
8 Function Selector Switch	OFF — Turns power off. MAIN — Receiver and transmitter operating on the same selected frequency. BOTH — Receiver and transmitter operating on same selected frequency; guard receiver operating on 243.000 MHz. ADF — Relative bearing to tuned station is displayed on navigation indicator or HSI.
9 Hinged Access Door for Preset Channel Set Switch	Must be raised for access to preset channel set switch.
10 Preset Channel Chart	On outer cover of hinged access door. Preset channel frequencies should be noted in appropriate space.
11 Volume Control	Controls volume of UHF reception.
12 Squelch Control Switch	ON — Eliminates background noise in UHF normal reception. OFF — Disables squelch to permit reception of a weak UHF signal.

COMMUNICATION CONTROLS (Figure 1-58) (Continued)

CONTROLS	FUNCTION	
13 COMM ANT Switch (Antenna Selector)	UPPER	—Selects upper UHF antenna in vertical stabilizer.
	AUTO	—Automatically selects upper UHF or lower UHF/IFF antenna.
	LOWER	—Selects lower UHF/IFF antenna.
14 Ⓕ INTERCOM Control Knob	Pull	—Turns on intercommunication system for communication between front and rear cockpits and ground crew when plugged in.
	Push	—Turns off intercommunication system between front and rear cockpits and to ground crew.
	Volume	—Rotated clockwise increases volume; counterclockwise rotation decreases volume.
15 Ⓕ COMM control transfer Switch (Front Cockpit)	FWD	—Front cockpit has control of UHF.
	AFT	—Rear cockpit has control of UHF.
16 Ⓕ COMM/NAV OVERRIDE Switch (Rear Cockpit)	ON	—Enables rear cockpit crewmember to take control of UHF radio and navigation equipment regardless of position of UHF radio and navigation transfer switches in front cockpit.
	Off	—Unmarked, guarded position permits use of UHF radio and navigation transfer switches in front cockpit.

NOTE

- ARC-150 radio may be substituted for ARC-164 radio.
- On aircraft equipped with antenna selector switch incorporating AUTO mode position, replacement of ARC-164 with ARC-150 radio will cause automatic antenna selection to operate improperly. Manual selection of UPPER or LOWER positions is required. AUTO position may be placarded INOP (inoperative) when ARC-150 is installed.

UHF AUTOMATIC DIRECTION FINDER (ADF) AN/ARA-50

The ARA-50 ADF operates in conjunction with the radio to provide bearing indication to any ground or airborne UHF station to which the radio is tuned. Any frequency in the standard UHF communications band may be used. Relative bearing information is displayed on the navigation indicator or HSI, when the ADF position is selected on the radio control panel. For [E-1] [F-1] and [T.O. 1F-5E-611], ADF information is displayed on the HSI when the NAV MODE selector is at DF. System accuracy is ±6 degrees in-flight with landing gear up.

NOTE

UHF/ADF homing signals are unreliable with landing gear in down position.

TACAN SYSTEM AN/ARN-65

The ARN-65 TACAN (TACtical Air Navigation) system (figure 1-59) provides distance, bearing, and course information and the capability to establish position continuously and instantaneously by reference to a TACAN ground (or airborne) station. TACAN information is displayed on the navigation indicator or HSI, and TACAN operation is described in the AHRS system description.

TACAN SYSTEM AN/ARN-84

The ARN-84 functions the same as the ARN-65 with the following additional capabilities:

a. Air-to-air mode (A/A position of the function selector switch) which provides DME capability for tracking and rendezvous with similarly-equipped aircraft out to 250 nm. Cooperating aircraft in A/A mode must select channels spaced exactly 63 channels apart. Bearing information is not provided, and bearing pointer rotates continuously, except during rendezvous with specially equipped tanker aircraft. The UHF/ADF can be used for bearing information in other airborne situations.
b. X and Y designations for each of the 126 channels (operating frequencies) doubles the number of channels available. Existing beacons are X-designated, and the Y-designations will be assigned to new beacons.
c. Self-test capability using the TEST control.

For E-1 F-1 and [T.O. 1F-5E-611], the NAV MODE selector must be at TACAN to obtain TACAN indications.

TACAN SYSTEM AN/ARN-118

The ARN-118 TACAN is operationally similar to the ARN-84 with the following additional capabilities:

a. Complete navigation information (range and bearing) with an airborne TACAN station.
b. Automatic self-test. When the TACAN signal becomes unreliable or is lost, the ARN-118 switches to an automatic self-test. Indications of the automatic self-test are

   1. TEST light will blink.
   2. Range shutter and OFF flag appear on HSI.
   3. Bearing pointer slews to 270 degrees for 7 seconds.
   4. Bearing pointer slews to 180 degrees, CDI centers, and TO indication appears for 15 seconds.

If the TEST light remains on after completion of test cycle, the TACAN has malfunctioned. For location and function of TACAN controls and indications, see figure 1-59.

X-BAND RADAR TRANSPONDER (SKYSPOT) SST-181

The radar beacon encoder-transponder system (skyspot) provides increased tracking capabilities for the X-band ground-based radar. A three-position switch placarded SST-181 on the right vertical panel (figure 1-15) (Ⓕ left console, figure 1-22) provides selection of OFF, DOUBLE, and SINGLE pulse reply. A 10-position code selector installed in the encoder-transponder is preset by the ground crew before flight for code pulse spacing. If code position 1 has been preselected, the transponder will provide only single pulse coded replies regardless of the position of the switch.

VOR/ILS NAVIGATION SYSTEM AN/ARN-127 [T.O. 1F-5E-611]

The ARN-127 navigation system consists of a receiver, a control panel, VOR-localizer and glide-slope antenna in the upper vertical tail, and a marker beacon antenna in the lower center fuselage. The system provides VOR navigation, localizer, and glide-slope information to the ADI and HSI (figures 1-55 and 1-56). The system operates on odd decimal frequencies from 108.10 to 111.95 MHz for ILS localizer and glide-slope information. Frequency range for VOR navigation information (displayed on the HSI) is the even decimal frequencies from 108.00 to 111.85 MHz and all frequencies from 112.00 to 117.95 MHz. See figure 1-60 for location and function of controls and indicators.

Instrument Landing System (ILS)

The ILS provides visual indications of glide-slope and localizer course. Paired localizer and glide-slope frequencies are automatically selected when the localizer frequency is selected. The ARN-127 navigation system operates in the ILS mode whenever the navigation mode selector is at VOR/ILS and and ILS frequency is selected. The pitch and bank steering bars on the ADI indicate amount and direction of deviation from the localizer course and glide slope. Marker beacon passage is indicated by flashing of the green marker beacon light on the instrument panel. See figure 1-60 for cockpit location and function of controls and indicators.

NAVIGATION CONTROLS (TYPICAL)

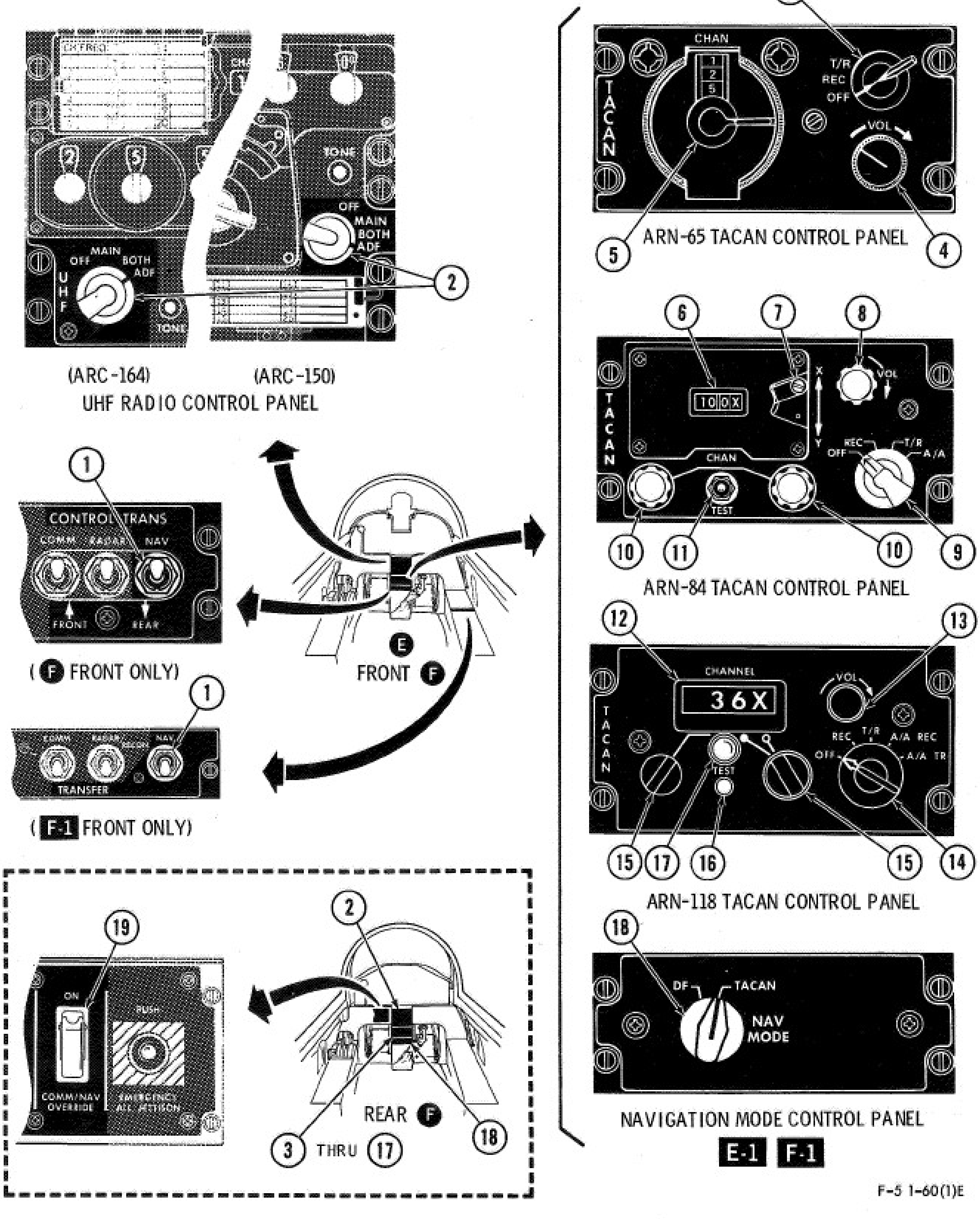

Figure 1-59.

NAVIGATION CONTROLS (Figure 1-59)

CONTROLS	FUNCTION
1 Ⓕ NAV CONTROL TRANS Switch (Front Cockpit)	FRONT — Front cockpit has control of TACAN. REAR — Rear cockpit has control of TACAN.
2 UHF Radio Functions Selector Switch	ADF — Relative bearing to tuned station is displayed on HSI.
ARN-65 (3 thru 5) 3 Mode Function Selector	OFF — Turns power off. REC — TACAN is receiving identification signals from selected station and provides bearing to station. T/R — TACAN is receiving as in REC mode and transmitting and receiving pulsed signals for distance indicating.
4 Volume Control	Controls volume of identification signals of selected TACAN channel.
5 Channel Selector (Inner and Outer Knobs and Channel Window)	Inner knob selects the units digit of the desired channel. Outer knob selects tens and hundreds digits of the desired channel. Selected channel number appears in window.
ARN-84 (6 thru 11) 6 Channel Selector Display Window	Displays selected channel and X/Y designation.
7 X/Y Selector Control	Positioning of control at X or Y selects corresponding designation on selected channel. Operative designation is displayed in channel selector display window.
8 Volume Control	Controls volume of identification signals of selected TACAN channel.
9 Function Selector Switch	OFF — Turns power off. REC — TACAN is receiving identification signals from selected station and provides bearing to station. T/R — TACAN is receiving as in REC mode, and transmitting and receiving pulsed signals for distance indicating. A/A — Receives and transmits (transponds) in Air-to-Air mode.
10 Channel Selector Controls	Right knob controls right (units) digit of channel number. Left knob controls first two digits (hundreds and tens) of channel number.
11 TEST Pushbutton	Push (Momentary) — With function selector switch at T/R or REC, DME will indicate 0 and bearing pointer 180 degrees. **NOTE** AHRS must be operating for ARN-84 self-test.
ARN-118 (12 thru 17) 12 Channel Selector Display Window	Displays selected channel and X/Y designation.

NAVIGATION CONTROLS (Figure 1-59) (Continued)

CONTROLS	FUNCTION
13 Volume Control	Control volume of identification signals of selected TACAN channel
14 Function Selector Switch	OFF — Turns off power. REC — Receiving identification signals from selected station and provides bearing to station. T/R — Transmitting and receiving. Provides bearing and range to station. A/A REC — Receiving identification signals from selected airborne station and provides bearing to station. A/A T/R — Transmitting and receiving. Provides bearing and range to selected airborne station.
15 Channel Selector Controls	Right knob controls right (units) digit of channel number and X/Y designation. Left knob controls first two digits (hundreds and tens) of channel number.
16 TEST Pushbutton	Push (Momentary) — With function selector switch at T/R, course set to 180 degrees, and any channel selected, observe the following: a. TEST light will blink. b. Range shutter and OFF flag appear on HSI. c. Bearing pointer slews to 270 degrees for 7 seconds. d. Range shutter and OFF flag disappear. e. Range window shows 000, bearing pointer slews to 180 degrees, CDI centers, and TO indication appears for 15 seconds. f. Range shutter and OFF flag reappear. **NOTE** If TEST light comes on during test, repeat test in REC mode. If light does not come on in REC mode, malfunction is probably in the transmitter and bearing information is valid. If light comes on in both T/R and REC, all information is invalid.
17 TEST light	Blink — System in test mode. On — TACAN has malfunctioned.
18 NAV MODE Selector (E-1 F-1 Only)	TACAN — HSI steering and navigation indications provided by TACAN. DF — HSI bearing pointer points to UHF station selected on UHF radio with radio function selector in MAIN or BOTH.
19 (F) COMM/NAV OVERRIDE Switch (Rear Cockpit)	ON — Enables rear cockpit crewmember to take control of UHF radio and navigation equipment regardless of position of control transfer switch in front cockpit. Off — Unmarked, guarded position permits use of UHF radio and navigation transfer switches in front cockpit.

NAVIGATION CONTROLS

[T.O. 1F-5E-611]

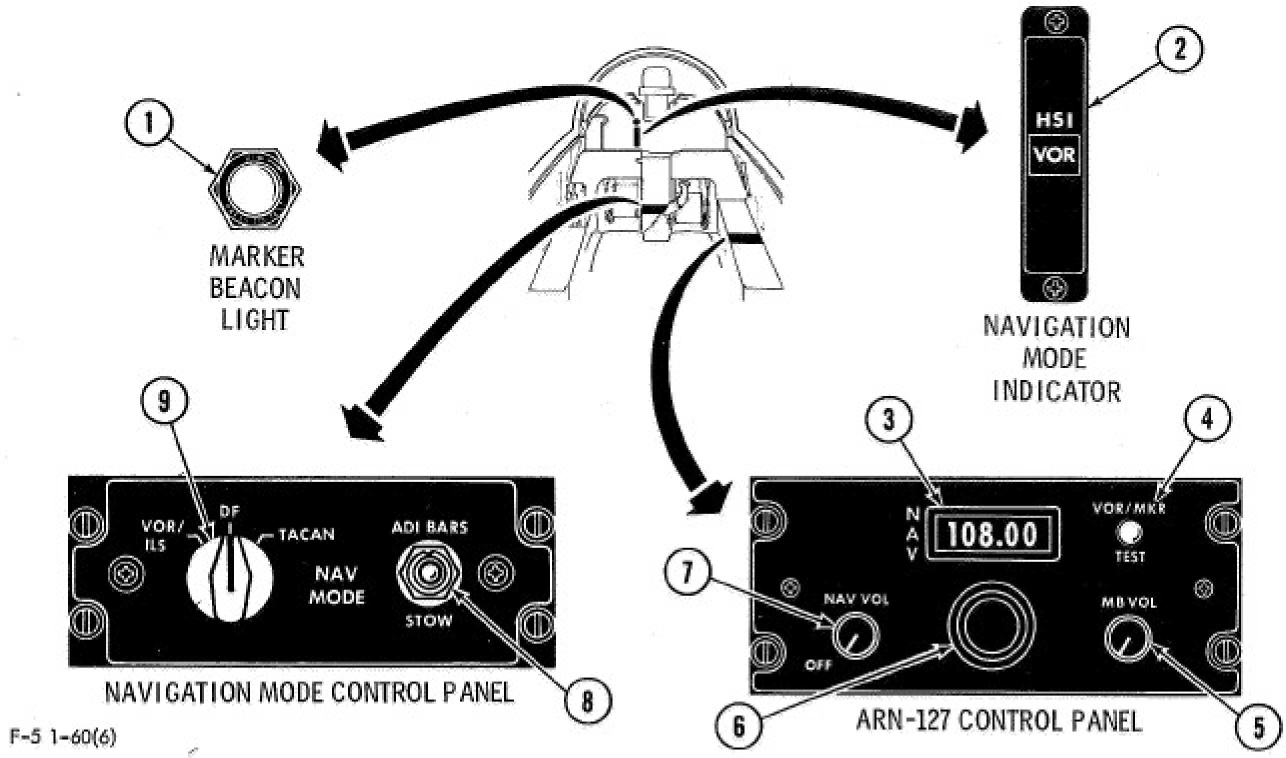

Figure 1-60.

NAVIGATION CONTROLS/INDICATORS (Figure 1-60) [T.O. 1F-5E-611]

CONTROLS/INDICATORS	FUNCTION
1 Marker Beacon Light (Green)	Flashes on and pulses beacon identification signals over marker beacon.
2 Navigation Mode Indicator	Lighted legend window displays navigation mode selected and operating mode of ADI and HSI. Indications are TCN, DF, VOR, and ILS.
VOR NAVIGATION CONTROLS (3 thru 7) 3 Frequency Readout Windows	Displays selected VOR/ILS frequencies.
4 VOR/MKR TEST Button	Self-tests receiver operation. With 315 set in course window, CDI, TO/FROM indicator shows TO, bearing pointer indicates 315, the OFF flag is not visible, and the marker beacon light illuminates.
5 MB VOL Knob	Clockwise rotation increases volume of marker beacon.
6 Frequency Select Knob(s)	Inner Knob —Selects fractional (.00-.95) MHz part of VOR/ILS frequencey. Outer Knob —Selects whole (108-117) MHz part of VOR/ILS frequency.

NAVIGATION CONTROLS/INDICATORS (Figure 1-60) [T.O. 1F-5E-611] (Continued)

CONTROLS/INDICATORS	FUNCTION	
7 OFF/NAV VOL Knob	Clockwise rotation turns receiver on and increases volume of VOR/ILS.	
8 ADI BARS/STOW Switch	ADI BARS	– Allows pitch and bank steering bars to come into view when an ILS frequency selected.
	STOW	– Stows pitch and bank steering bars.
9 NAV MODE Selector	VOR/ILS	– Provides VOR navigation data to HSI when VOR frequencies selected.
		– Provides ILS localizer steering information to ADI and HSI, and glide-slope information to ADI when ILS frequencies selected. Alerts marker beacon light.
	DF	– HSI bearing pointer points to UHF station selected on UHF radio with radio function selector in MAIN or BOTH.
	TACAN	– Provides TACAN navigation data to HSI.

IFF/SIF SYSTEM AN/APX-72 OR AN/APX-101

The IFF/SIF system (figure 1-61) is an airborne pulse transponder which receives coded interrogations from surface or airborne radar (IFF) and automatically transmits coded selective identification (SIF). It is not capable of interrogating other stations. The system operates in five modes and is capable of I/P (Identification of Position) and emergency identification. The modes are: 1 – Security Identify; 2 – Self Identify; 3 – Air Traffic Identify; 4 (Classified) – Security Identify (when installed); and C – Altitude Reporting. The equipment consists of a control panel (Ⓕ front cockpit only) (figure 1-48), a transponder (transmitter-receiver), an airborne test set/in-flight monitor, and an antenna switching unit (lobing switch) in the nose section. The receiver will respond only to interrogations in the selected mode and code. Mode 2 is preset into the transponder. An altitude encoder in the CADC provides an interrogating ground station with the aircraft altitude. Automatic altitude reporting is corrected pressure altitude computed by the CADC. The system does not automatically trigger an emergency code upon ejection. The emergency code can be manually selected.

IFF/SIF CONTROLS/INDICATOR (TYPICAL)

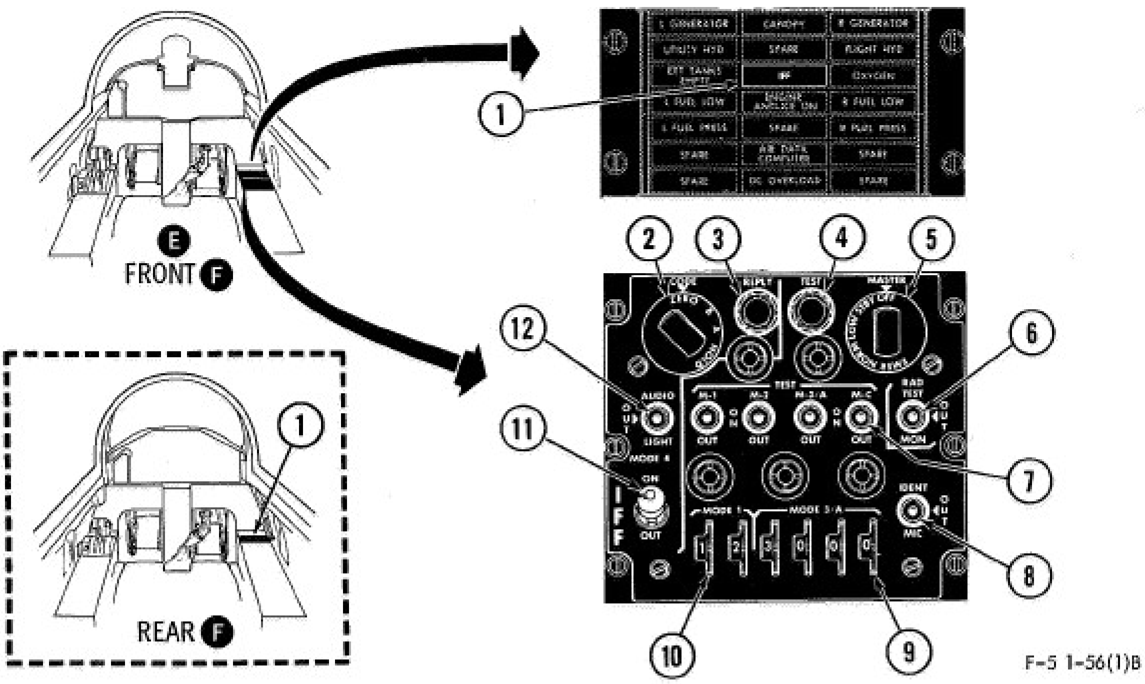

Figure 1-61.

IFF/SIF CONTROLS (Figure 1-61)

CONTROLS	FUNCTION	
1 IFF Caution Light (Ⓕ Both Cockpits)	Comes on when mode 4 interrogations are not properly processed and replied to or mode 4 code is zeroed.	
2 MODE 4 CODE Selector	ZERO (Pull and Rotate)	— Erases mode codes.
	B	— Selects preset codes.
	A	— Not used.
	HOLD (Momentary)	— Retains preset codes when landing gear is down provided 15 seconds pass before turning battery switch off.
3 MODE 4 REPLY Light	Comes on when receiver-transmitter responds to mode 4 interrogations.	
4 Radiation TEST and Monitor Light	Illuminates when receiver-transmitter responds properly to Modes 1, 2, 3/A, or C.	
5 MASTER Control Selector	OFF	— Disconnects power to system.
	STBY	— Places receiver-transmitter in warmup (standby condition). Allow a minimum of 1 minute when system is first turned on.

IFF/SIF CONTROLS (Figure 1-61) (Continued)

CONTROLS	FUNCTION	
5 MASTER Control Selector (Continued)	LOW	—Applies power to receiver-transmitter but at reduced receiver sensitivity. Only local (strong) interrogations are recognized and answered.
	NORM	—Applies power to receiver-transmitter at normal receiver sensitivity for full range operation.
	EMER (Pull and Rotate)	—Transmits emergency reply signals to modes 1,2, or 3/A interrogations regardless of mode control settings. In addition, Mode 3 (7700) is transmitted automatically.
6 RAD TEST/MON Switch	RAD TEST	—Permits reply to test mode interrogations from test equipment.
	MON	—Monitors station interrogations and coded reply. Test light will illuminate when replies are transmitted in response to interrogations in Modes 1,2,3/A, or C.
	OUT (Spring-loaded from RAD TEST)	—Deenergizes RAD TEST and MON. Switch is placed in OUT position and is not used during flight.
7 Mode Select/TEST Switches	ON (Spring-loaded from TEST)	—Permits receiver-transmitter reply to Modes 1,2,3/A, or C interrogations.
	OUT	—Disables the receiver-transmitter for the mode selected.
	TEST	—Built-in test function in receiver-transmitter self-interrogates Modes 1,2,3/A, or C.
8 Identification of Position (IP) Switch	IDENT (Momentary)	—Initiates identification of reply for approximately 20 seconds.
	OUT (Spring-loaded from IDENT)	—Prevents triggering of IP reply.
	MIC	—Permits IP replies to be transmitted by pressing microphone button.
9 MODE 3/A Code Selectors	Selects and displays Mode 3/A four-digit reply code number. For Traffic Identification.	
10 MODE 1 Code Selectors	Selects and displays Mode 1 two-digit reply code number. For Security Identification.	
11 MODE 4 Control Switch	ON	—Permits reply to Mode 4 interrogations.
	OUT	—Disables Mode 4.
12 MODE 4 Monitor Control Switch	AUDIO	—Audible tone is heard and REPLY light comes on when Mode 4 responds.
	OUT	—Disables audible tone and REPLY light.
	LIGHT	—REPLY light comes on when Mode 4 responds.

WARNING, CAUTION, AND INDICATOR LIGHTS SYSTEM

Warning, caution, and indicator lights warn of failures critical to flight, hazardous or potentially hazardous conditions, or of a change in system status requiring awareness and possible action. The lights consist of two red FIRE warning lights, a red "gear unsafe" warning light in the landing gear lever, a yellow MASTER CAUTION light, a yellow ARREST HOOK down light, three green landing gear position indicator lights, AOA indexer lights, and a caution light panel with 21 individual word capsules (yellow) for individual aircraft systems. A full set of warning, caution, and indicator lights is provided in both cockpits Ⓕ. A WARNING test switch on the lighting control panel (right console) permits testing the lights and FIRE WARNING circuits. A three-position BRT/ DIM switch, spring-loaded to the neutral position, allows a selection of bright or dim operating modes (See figure 1-62 for switch locations and operation). Warning, caution, and indicator lights are powered by the dc bus in the bright mode and by the right ac bus in the dim mode.

CAUTION LIGHT PANEL

The caution light panel (figure 1-62) contains 21 individual system word capsules, including seven spare capsules (Ⓕ [E-1] six). Spare capsules illuminate only when the WARNING test switch is positioned to TEST. Each light when illuminated, except ENGINE ANTI-ICE ON, will remain on as long as the malfunction exists or the status is unchanged. The individual system caution light will not go out when the MASTER CAUTION light is reset to rearm the circuit. The ENGINE ANTI-ICE ON light will go on when the engine anti-ice switch is in the ON position. For functions of other individual caution lights, see the appropriate system description.

CAUTION

The master caution light must be reset after each activation to provide warning of subsequent activation of caution lights.

WARNING, CAUTION, AND INDICATOR LIGHTS (TYPICAL)

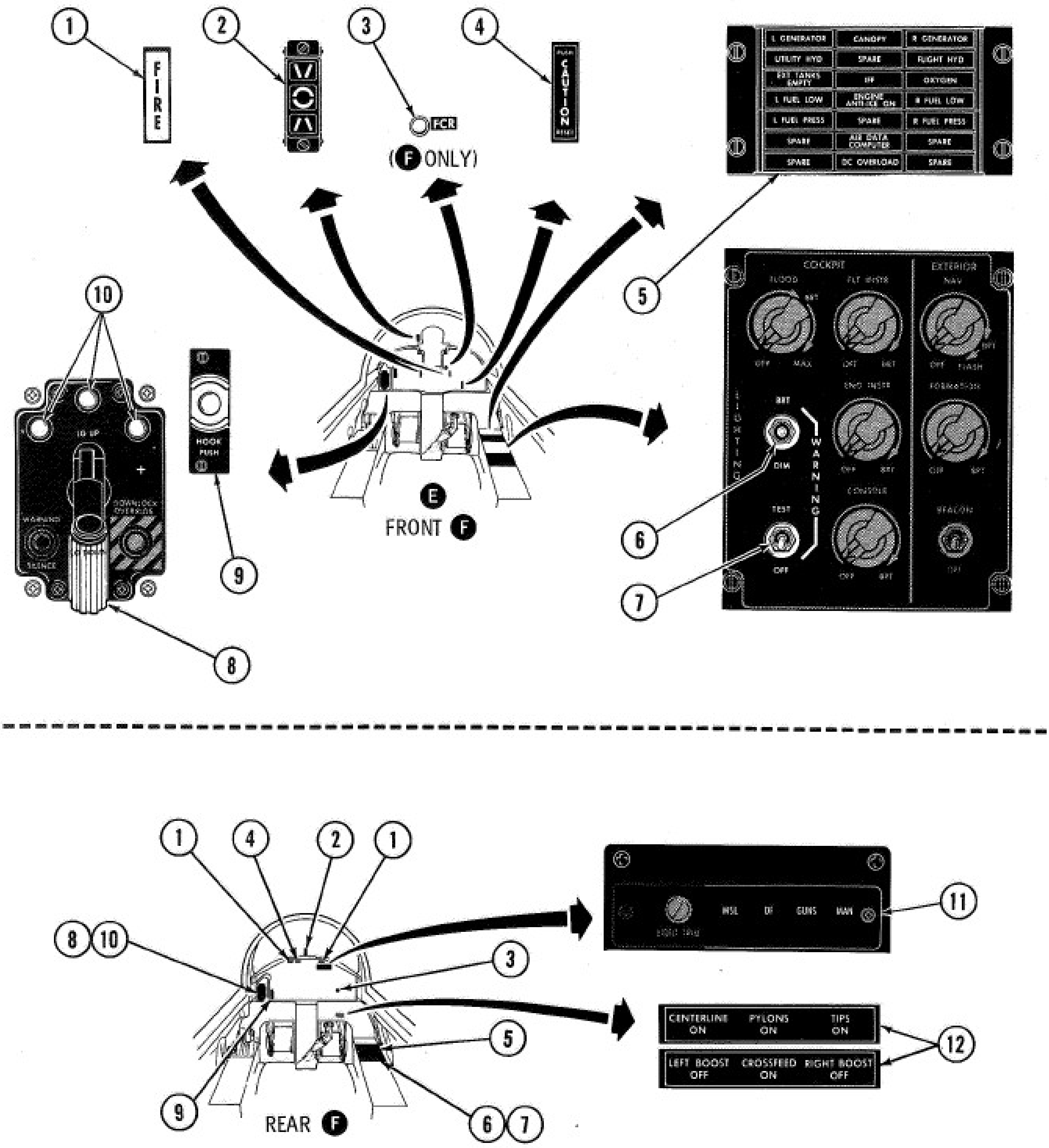

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Figure 1-62.

WARNING, CAUTION, AND INDICATOR LIGHTS & CONTROLS (Figure 1-62)

	CONTROLS	FUNCTION	
1	Engine Compartment Fire Warning Lights (RED)	See: ENGINE CONTROLS/INDICATORS.	
2	Angle-of-Attack Indexer Lights (RED, GREEN, YELLOW)	See: ANGLE-OF-ATTACK SYSTEM.	
3	FCR Light (Green) (Ⓕ Both Cockpits)	Refer to T.O. 1F-5E-34-1-1.	
4	MASTER CAUTION Light (YELLOW)	On	— Illuminates when a caution light capsule is on.
5	Caution Light Panel Lights (YELLOW)	On	— Indicates system status or malfunction in the applicable system.
6	BRT/DIM Switch (Spring-loaded to Center)	BRT (Momentary)	— Warning, caution and indicator lights will illuminate when activated in bright mode, powered by 28-volt dc bus.
		DIM (Momentary)	— With flight instrument lights on, warning, caution, and indicator lights will operate, when activated in dim mode, powered by right ac bus. With flight instrument lights off, or if ac power is lost, warning, caution, and indicator lights operate in bright mode.
7	WARNING TEST Switch (Spring-loaded OFF)	TEST	— Turns on all warning, caution, and indicator lights in the cockpit being tested and tests gear audible warning, fire warning sensing loop in each engine compartment, and angle-of-attack indexer lights.
8	Landing Gear Lever Warning Light (RED)	See: LANDING GEAR CONTROLS/INDICATORS.	
9	HOOK PUSH Button Light (In Button) (YELLOW)	See: ARRESTING HOOK SYSTEM.	
10	Landing Gear Position Indicator Lights (GREEN)	See: LANDING GEAR CONTROLS/INDICATORS.	
11	SIGHT MODE Indicator Lights (Ⓕ Rear Cockpit) (White)	Refer to T.O. 1F-5E-34-1-1.	
12	Fuel System Indicator Lights Upper (GREEN); Lower (YELLOW); (Ⓕ Rear Cockpit)	See: FUEL SYSTEM CONTROLS/INDICATORS.	

WARNING TEST SWITCH

The warning test switch on the right console lighting control panel (figure 1-62) tests all warning, caution, and indicator lights in the cockpit as well as the landing gear audible warning signal, fire detection sensing loops, and angle-of-attack indexer.

WARNING TEST SWITCH Ⓕ

When the test switches in both cockpits are actuated simultaneously, the fire warning lights and the landing gear audible warning signal will not come on in either cockpit. When the warning test switch is released in a cockpit, the fire warning lights in the other cockpit may illuminate momentarily.

LIGHTING EQUIPMENT

The aircraft is equipped with exterior and interior lighting. Exterior lights controlled from the cockpit lighting control panel consist of dual retractable, landing-taxi lights, position (navigation) and fuselage lights, formation lights, and an anticollision beacon. Interior lights consist of flight and engine instrument lights, console and panel lights, cockpit floodlights, thunderstorm lights (Ⓔ only), and a utility light. See figure 1-63 for location and function of lighting controls and figure 1-64 for location of interior and exterior lights.

EXTERIOR LIGHTS

Landing-Taxi Lights

Two white landing-taxi lights, one under each engine nacelle, are electrically controlled, two-position, retractable lights. In flight with the gear down and NAV rheostat out of OFF detent, the landing-taxi lights will extend automatically to the landing (fully extended) position. The lights will retract and go out automatically when the gear is raised or the position lights are turned off. With the lights extended for landing, the LDG & TAXI LIGHT switch ON position illuminates the high intensity beam in each light. With the aircraft weight on the main gear, the landing-taxi lights retract to the intermediate or taxi-light position and each beam is automatically reduced to low intensity for taxiing.

Position and Fuselage Lights

Primary position lights are engine nacelle mounted (left-red, right-green). Auxiliary position lights are in outer wing panels (left-red, right-green). The tail position light is in the vertical stabilizer (white). Each auxiliary position light has an inboard white segment which illuminates the aft fuselage and vertical stabilizer for night formation flying. Position lights are controlled by the NAV rheostat. Two white fuselage lights, on either side of the lower fuselage centerline forward of the landing-taxi lights, come on steady-bright when the NAV control is placed in the FLASH position.

Formation Lights and Rotary Beacon

Formation lights, controlled by the FORMATION rheostat, consist of paired white dorsal lights aft of the cockpit and aft end mounted missile launcher lights (left-red, right-green) [T.O. 1F-5-736]. A rotating anti-collision beacon (red) in the vertical stabilizer is controlled by the BEACON switch. On unmodified aircraft, the missile launcher lights are not installed.

NOTE

> Left launcher rail formation lights will be removed when TDU-11/B target rocket is carried on left launcher rail.

INTERIOR LIGHTS

Flight and Engine Instrument Lights

Flight and engine instrument indicators on the instrument panel, right vertical panel, and right console are white-lighted by internal lamps. These lights operate off the right ac bus and are controlled by FLT INSTR and ENG INSTR rheostats on the lighting control panel.

Armament Panel Lights

Armament panel lights on the left vertical panel provide backlighting for the armament panel and optical sight. Controlled by the ARMT LIGHT CONTROL rheostat switch on left vertical panel, [T.O. 1F-5E-573], the lights operate off the left ac bus. On unmodified aircraft, sight panel lighting is controlled by the CONSOLE rheostat.

Console Lighting

Console lighting includes integral backlighting in the consoles, pedestals, vertical, optical sight (unmodified aircraft) and radar panels. Backlighting illuminates legends and markings on controls, control panels, and instruction plates. Console lighting is powered by the left ac bus and is controlled by the CONSOLE rheostat on lighting control panel.

Floodlights

Cockpit floodlighting consists of flush-mounted white floodlights under the instrument panel glare shield, two recess-mounted white floodlights on each side of the cockpit interior trim panels for illumination of the console panels, and thunderstorm lights on each side of the rear bulkhead of the cockpit (Ⓔ only). The console floodlights and Ⓔ thunderstorm lights are turned on by the FLOOD rheostat knob on the lighting control panel and serve as an alternate lighting source. The instrument panel floodlights on-off and intensity are controlled by the FLOOD rheostat knob only when ac power is available. The Ⓔ thunderstorm lights are turned on by rotating the FLOOD rheostat knob past the 3 o'clock position. The floodlights normally operate on ac power. If ac power is lost or not available, the floodlights will operate on dc power whenever the battery switch is at BATT and the ENG INSTR and FLOOD rheostats are out of OFF.

LIGHTING CONTROLS

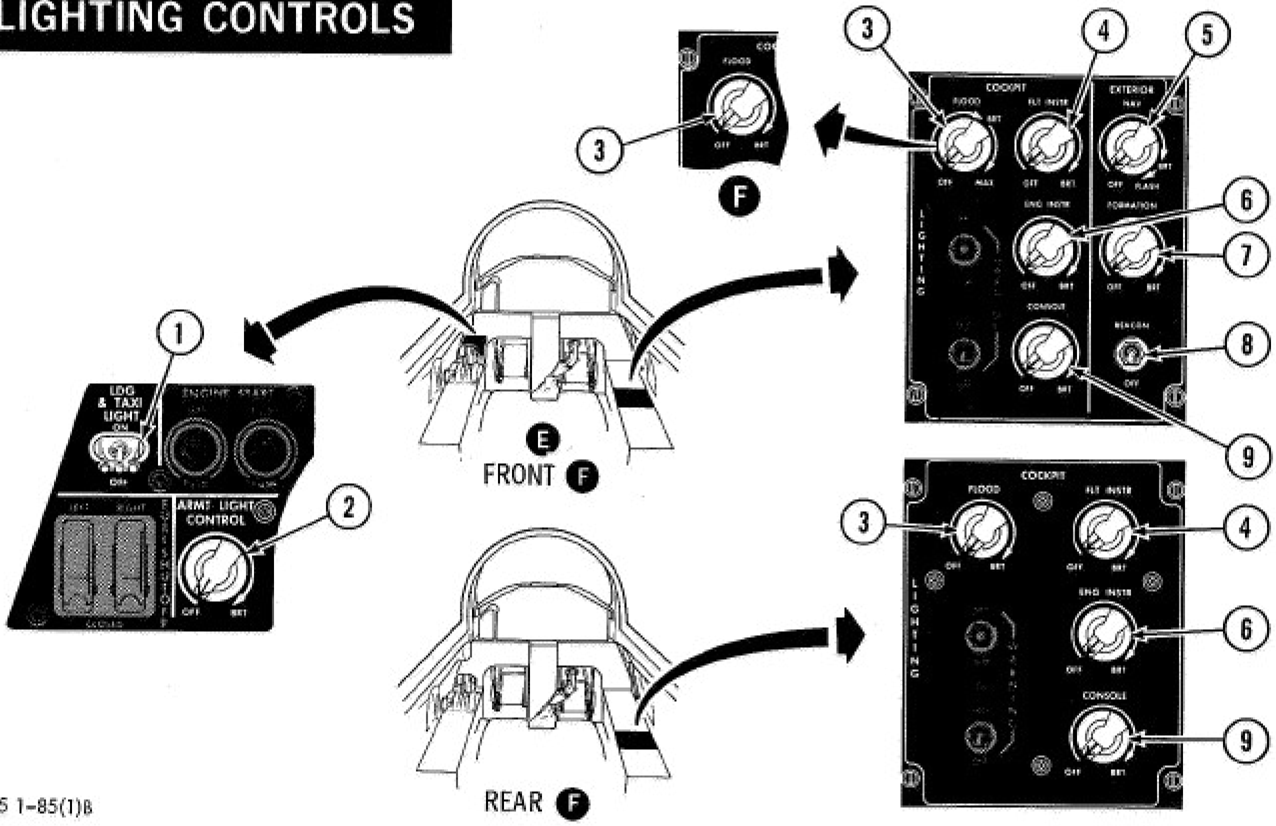

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Figure 1-63.

LIGHTING CONTROLS (Figure 1-63)

CONTROLS	FUNCTION
1 LDG & TAXI LIGHT Switch (Ⓕ Front Cockpit)	ON — Turns on both landing-taxi lights when the gear is extended and the position lights are on. OFF — Turns off landing-taxi lights.
2 ARMT LIGHT CONTROL Knob (Ⓕ Front Cockpit)	Turns on and controls intensity of the armament and sight panel lights.
3 FLOOD Knob	Turns on and controls intensity of floodlights and thunderstorm lights. Three-o'clock position of switch turns on thunderstorm lights, prevents caution light dimming. (Ⓕ not equipped with thunderstorm lights).
4 FLT INSTR Knob	Turns on and controls intensity of flight instrument lights. (Prevents dimming of caution lights when turned off.)
5 NAV Knob (Position light control) (Ⓕ Front Cockpit)	OFF — Turns off all position lights. Movement out of OFF detent turns on the auxiliary and tail position lights. Clockwise rotation of knob brightens the auxiliary lights while the taillight remains dim; primary lights remain off. BRT — Auxiliary and tail position lights at full intensity. Primary lights come on bright. FLASH — Primary and tail position lights — bright and flash. Auxiliary position lights — bright and steady. Lower fuselage lights come on bright and steady.
6 ENG INSTR Knob	Turns on and controls intensity of engine instrument lights.
7 FORMATION Knob	Turns on and controls intensity of formation lights.
8 BEACON Switch (Ⓕ Front Cockpit)	BEACON — Turns on rotary beacon light. OFF — Turns off rotary beacon light.
9 CONSOLE Knob	Turns on and controls intensity of edgelighting of consoles, pedestal, vertical, instrument, radar, and sight panels.

Utility Light

The utility light is on the right interior trim panel of the cockpit (Ⓕ both cockpits). The light is controlled by a self-contained rheostat switch which can be rotated to turn the lamp on and vary the lamp intensity. A lens cap provides selection of red or white spot or floodlighting. In an emergency, pressing the pushbutton switch on the light assembly provides full intensity of the lamp and permits use as a signaling light when the pushbutton is intermittently pressed. The light, equipped with an extension cord, is hand portable and can be detached from its support to allow use anywhere in the cockpit. Auxiliary mounting supports are provided for relocation of the light, if desired (lower right corner of the cockpit windshield frame.)

WARNING

Stow utility light after use to prevent interference with the ejection seat and possible inadvertent initiation of the man-seat separation system.

LIGHTING EQUIPMENT

INTERIOR

1 CONSOLE FLOODLIGHTS
2 INSTRUMENT PANEL FLOODLIGHTS
3 UTILITY LIGHT (STOWED POSITION)
4 UTILITY LIGHT (ALTERNATE LOCATION)
5 THUNDERSTORM LIGHTS (E ONLY)

EXTERIOR

6 FORMATION LIGHT (EACH SIDE)
7 FORMATION LIGHT [T.O. 1F-5-736]
8 AUXILIARY POSITION LIGHT (TOP & BOTTOM)
9 ROTARY BEACON LIGHT (EACH SIDE)
10 TAIL POSITION LIGHT
11 PRIMARY POSITION LIGHT (EACH SIDE)
12 LANDING-TAXI LIGHTS (EXTENDED)
13 FUSELAGE LIGHTS

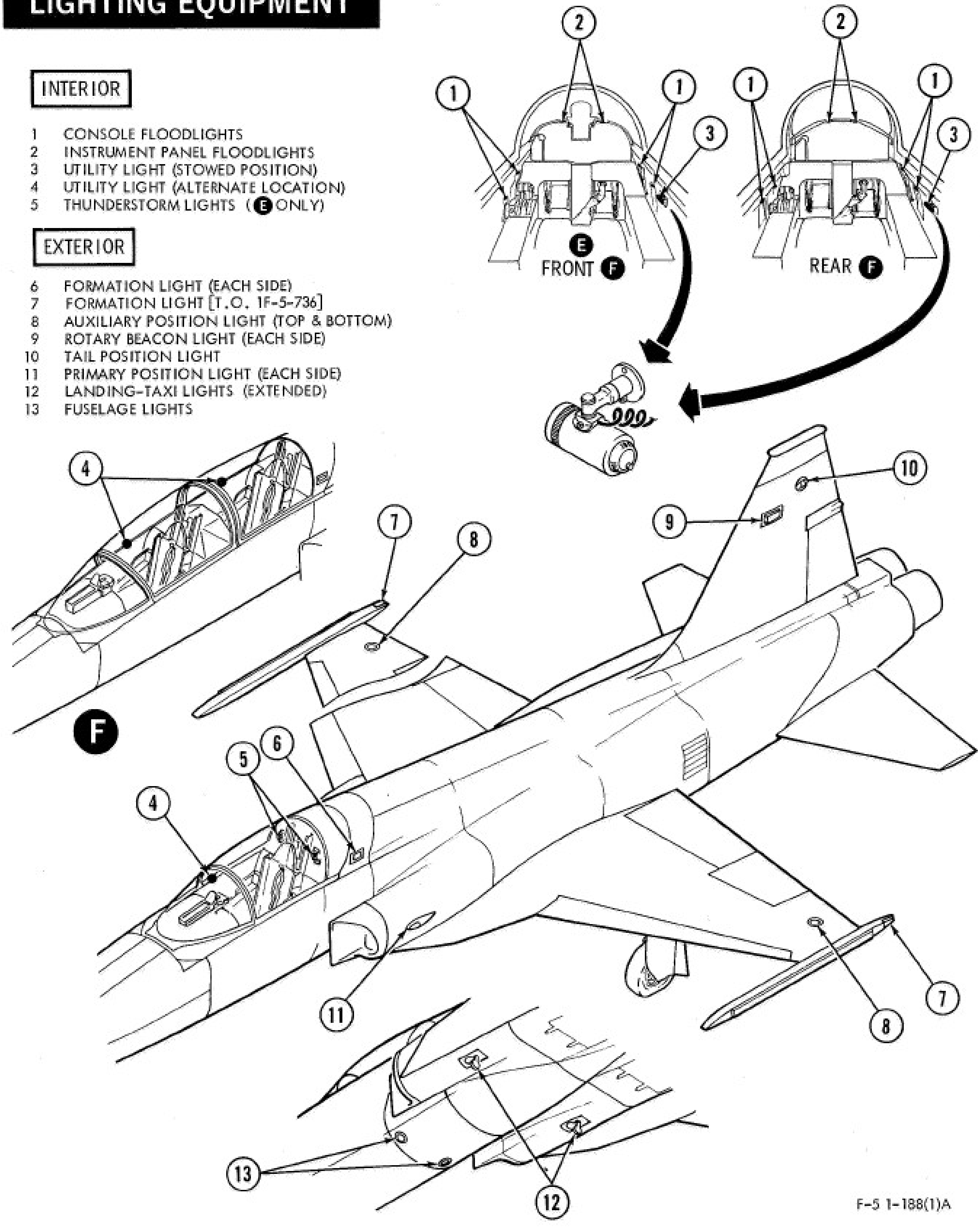


Figure 1-64.

OXYGEN SYSTEM

A 5-liter liquid oxygen system supplies breathing oxygen. An oxygen regulator on the right console controls the flow and pressure of the oxygen and distributes it in the proper proportions to the mask. The oxygen regulator contains a gage, a blinker type flow indicator, emergency flow lever, oxygen diluter lever, and supply lever. Controls and indicators are provided in both Ⓕ cockpits.

OXYGEN REGULATOR

A combination pressure breathing, diluter demand, oxygen regulator (figure 1-65) is used in conjunction with the oxygen mask. The oxygen system is controlled by the supply, diluter, and emergency levers. An interlock between the supply lever and diluter lever causes the diluter lever to trip to 100% position when supply lever is at OFF, preventing any flow of air thru system. Gaseous oxygen is supplied to the regulator in the range of 65 to 110 psi. The regulator reduces the oxygen pressure, mixes oxygen with air in varying amounts, depending on altitude and demand, and delivers it thru a flexible hose to the oxygen mask. At high altitude, the regulator supplies positive pressure breathing. System operation is indicated by the flow indictor and oxygen pressure gage on the oxygen regulator panel. The emergency lever should remain at NORMAL unless an unscheduled pressure increase is required.

WARNING

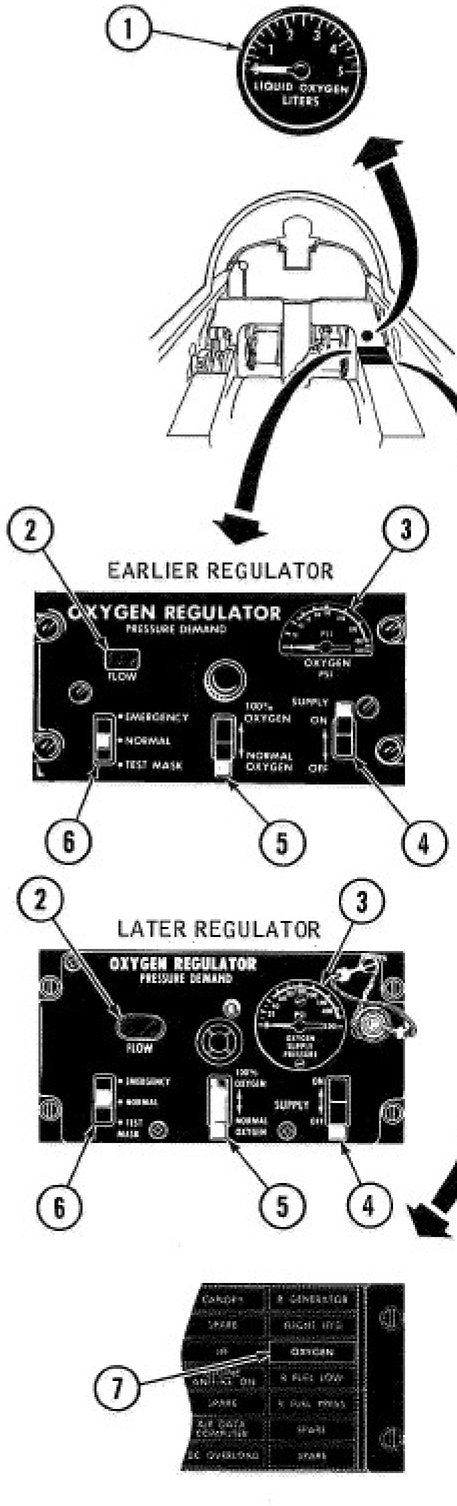
When placing the emergency lever at EMERGENCY or TEST MASK, it is mandatory that the oxygen mask be fitted to the face and not removed. Continuous use of positive pressure with a leaking oxygen mask or the mask removed for extended periods will deplete the oxygen supply rapidly.

OXYGEN CONTROLS/INDICATORS

COCKPIT ALTITUDE—FEET		DURATION IN HOURS						
35,000 & ABOVE	E	31	25	19	12	6.2	3.1	EMERGENCY DESCEND TO ALTITUDE NOT REQUIRING OXYGEN.
		31	25	19	12	6.2	3.1	
	F	15	12	9.3	6.2	3.1	—	
		15	12	9.3	6.2	3.1	—	
30,000	E	23	18	14	9.1	4.5	2.3	
		23	18	14	9.2	4.6	2.3	
	F	11	9.1	6.8	4.5	2.3	—	
		11	9.2	6.9	4.6	2.3	—	
25,000	E	17	14	10	7.0	3.5	1.8	
		22	17	13	8.7	4.3	2.2	
	F	8.7	7.0	5.2	3.5	1.8	—	
		11	8.7	6.5	4.3	2.2	—	
20,000	E	13	11	7.9	5.3	2.6	1.3	
		24	20	15	9.8	4.9	2.5	
	F	6.6	5.3	4.0	2.6	1.3	—	
		22	9.8	7.3	4.9	2.5	—	
15,000	E	11	8.5	6.4	4.2	2.1	1.1	
		30	24	18	12	6.0	3.0	
	F	5.3	4.2	3.2	2.1	1.1	—	
		15	12	9.0	6.0	3.0	—	
10,000	E	8.5	6.8	5.1	3.4	1.7	0.9	
		30	24	18	12	6.0	3.0	
	F	4.3	3.4	2.6	1.7	0.9	—	
		15	12	9.0	6.0	3.0	—	
LIQUID CONTENTS—LITERS		5	4	3	2	1	½	BELOW: ½ E F ONE CREW; 1 F TWO CREW

- TOP FIGURES INDICATE DILUTER LEVER "100% OXYGEN".
- BOTTOM FIGURES INDICATE DILUTER LEVER "NORMAL OXYGEN".

F FIGURES ARE FOR TWO CREW.
E FIGURES ARE TO BE USED FOR F ONE CREW.



E AND F FRONT SHOWN — F REAR IDENTICAL

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Figure 1-65.

OXYGEN SYSTEM CONTROLS/INDICATORS (Figure 1-65)

CONTROLS/INDICATORS	FUNCTION
1 Oxygen Quantity Indicator	Indicates oxygen supply in converter from 0 to 5 liters. The indicator is ac powered.
2 FLOW Indicator	Blinks alternately black and white, indicating air-oxygen flow during pilot's breathing.
3 Pressure Gage	Indicates gaseous oxygen pressure in psi at regulator.
4 SUPPLY Lever (Earlier Regulators)	OFF — Shuts off all oxygen to mask. ON — Turns on oxygen to mask. **WARNING** Ⓔ It is possible for the supply lever of early regulators to stop in an intermediate position between OFF and ON. Care should be taken to push the supply lever fully ON and visually check the flow indicator blinker for proper functioning.
SUPPLY Lever (Later Regulators)	OFF — Shuts off all air-oxygen to mask. ON — Turns on air-oxygen to mask.
5 Diluter Lever	100% OXYGEN — Provides regulated 100% oxygen flow to mask. NORMAL OXYGEN — Provides regulated mixture of cockpit air-oxygen flow to mask as determined by cockpit altitude.
6 Emergency Lever	EMERGENCY — Provides continuous pressure-demand flow of 100% oxygen to mask. NORMAL — Provides demand air-oxygen flow to mask. TEST MASK — Provides increased positive pressure flow to test mask and hose for leaks.
7 OXYGEN Caution Light	On (OXYGEN) — Illuminates when the liquid oxygen level in the converter is 0.5 liter or less, or that supply pressure is low (40 psi or less).

CANOPY

The cockpit (Ⓕ both cockpits) is enclosed by a manually controlled one-piece clamshell type canopy. The canopy is counter-balanced throughout its travel limits. The canopy drive mechanism is protected against excessive loads by a hydraulic damper, which also restricts canopy opening and closing speeds. An inflatable seal in the canopy will inflate only when the canopy is locked and an engine is operating. Exterior and interior normal and jettison controls consist of locking handles and jettison handles and a canopy caution light. The exterior and interior locking handles must be used only to lock and unlock the canopy. Raising and lowering the canopy must be done by hand pressure applied to the canopy frame.

CAUTION

Damage to canopy drive mechanism may result if the locking handles are used to raise and lower the canopy.

The canopy jettison handle in the cockpit (Ⓕ both cockpits) is safetied by a removable safety pin. After the pin is removed, a spring clip which safeties the handle must be overridden when the handle is pulled. See figure 1-66 for location of controls and caution light.

CANOPY CONTROLS/ INDICATORS

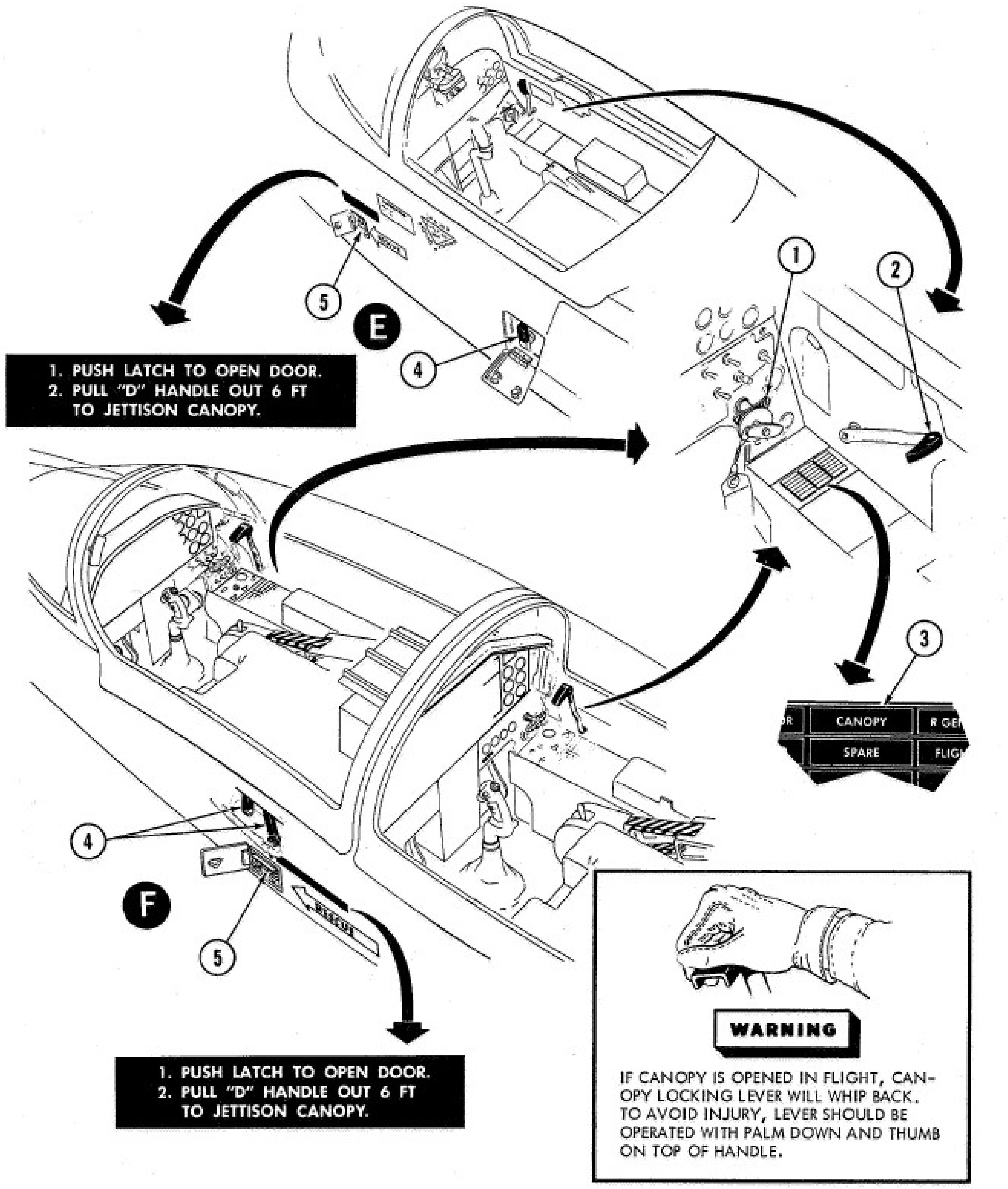

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Figure 1-66.

CANOPY CONTROLS/INDICATOR (Figure 1-66)

CONTROLS/INDICATOR	FUNCTION	
1 CANOPY JETTISON T-Handle	Pull	—Jettisons canopy independent of seat ejection.
2 Canopy Handle (Interior)	Fully Forward	—Canopy locked.
	Pull Aft	—Unlocks canopy.
3 CANOPY Caution Light	Off	—Canopy locked. (Ⓕ Both canopies locked.)
	On	—Canopy unlocked. (Ⓕ Either or both canopies unlocked.)
4 Canopy External Locking Handle (Exterior)	Pull Out and Turn CW	—Unlocks canopy.
	Turn CCW	—Locks canopy.
5 Canopy Jettison D-Handle (Each side of fuselage)	Pull (Either Handle)	—(Approximately 6 feet) Jettisons canopy (Ⓕ both canopies); front first, followed 1 second later by rear canopy).

EJECTION SEAT (STANDARD AND IMPROVED)

The cockpit (Ⓕ each cockpit) is equipped with the Standard or Improved rocket catapult ejection seat (figure 1-67 and 1-68). Both seats include a seat adjusting unit and control switch, an automatic-opening safety belt, shoulder harness, inertia reel locking lever, headrest, canopy piercer, calfguard, two legbraces, two catapult firing triggers, a jettison initiator, a survival kit container, a man-seat separator system, and a seat ejection sequencer (Ⓕ only). The Improved seat additionally includes a drogue chute, which stabilizes the seat (and pilot) during ejection, and a survival kit incorporating an automatic deployment capability. Either seat will eject thru the canopy if canopy jettison fails. See section III for ejection envelopes and escape parameters.

WARNING

Do not disconnect the retention strap from the oxygen hose. The strap gives the straight downward pull required to disconnect the hose during man-seat separation.

LEGBRACES

Legbraces with handgrips incorporating firing triggers are interconnected and attached to the seat. Raising the legbraces to the fully up and locked position with the handgrips locks the shoulder harness (Ⓔ only) and exposes the firing triggers. After the legbraces have been raised to the locked position, they cannot be lowered to the stowed position.

NOTE

With the seat fully down and the legbraces raised, space between the firing triggers and consoles is severely reduced.

INERTIA REEL LOCK

An inertia reel lock consisting of a reel (Ⓕ gas-driven power reel) and cable attachment provides mechanical locking and unlocking of the shoulder harness controlled by an inertia reel lock lever (figures 1-67 and 1-68). With the harness locked, (LOCK position) any slack remaining in the harness can be reduced by sitting back in the seat. The slack will then be reeled in to assume a new locked position. When unlocked, (AUTO position) the harness is free to reel in and out. A rapid acceleration of 3g or more will automatically lock the reel and keep it locked until the lock lever is cycled. In the Ⓔ, when the handgrips are raised, the shoulder harness is locked. In the Ⓕ, when the

EJECTION SEAT – STANDARD

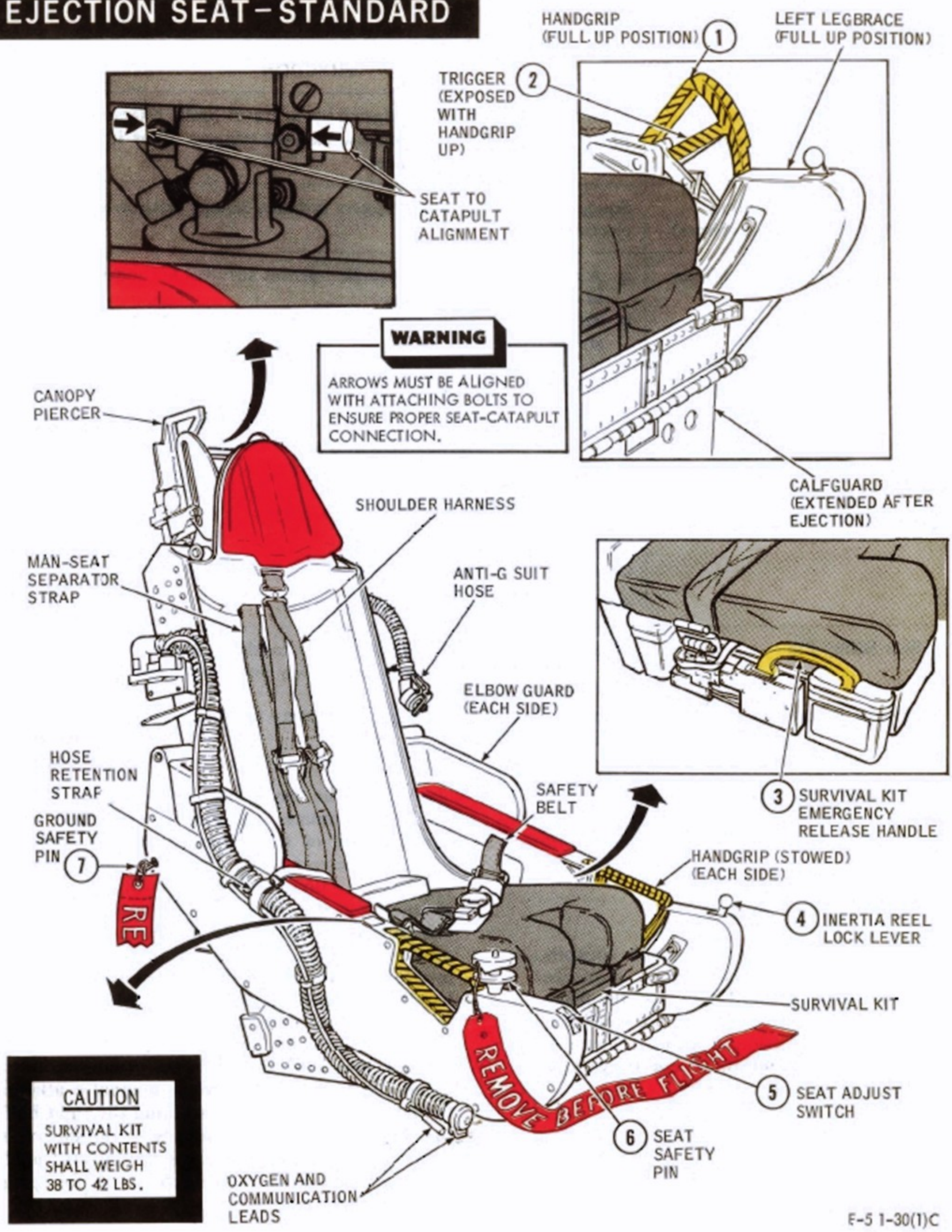


Figure 1-67.

EJECTION SEAT —STANDARD (Figure 1-67)

CONTROLS	FUNCTION
1 Handgrips (Yellow with black diagonal stripes)	Pulling either or both handgrips up to travel limits raises legbraces to fully up and locked position and exposes triggers. First 12 degrees of travel unlocks both legbraces.
2 Firing Triggers (Yellow with black diagonal stripes)	Squeezing either or both triggers initiates canopy jettison and seat ejection.
3 Emergency Release Handle	a. After ejection, pulling handle releases survival kit and inflates life raft (if installed). b. While seated in aircraft, pulling handle releases both attaching straps from kit.
4 Inertia Reel Lock Lever	LOCK — Locks shoulder harness. AUTO — Unlocks shoulder harness, freeing it to reel in and out. Harness will automatically lock during rapid 3-g acceleration and/or during seat ejection.
5 Seat Adjust Switch	Forward and Hold — Lowers seat electrically. Center — Spring-loaded neutral position. Aft and Hold — Raises seat electrically.
6 Seat Safety Pin	Inserted — Holds right legbrace handgrip down. The streamer is attached to the canopy jettison pin streamer.
7 Ground Safety Pin	Provides mechanical safing of the safety belt initiator during ground maintenance.

firing triggers are squeezed, the power-reel is acutated causing the shoulder harness to be forcibly retracted and locked, regardless of the position of the lock lever.

NOTE

Ⓕ The shoulder harness in both cockpits will retract when the ejection sequence selector is set at NORMAL and the firing triggers in the front cockpit are squeezed, or when the ejection sequence selector is set at DUAL and the firing triggers in either cockpit are squeezed.

AUTOMATIC-OPENING SAFETY BELT

The ejection seat is equipped with an HBU-2B/A safety belt. The belt incorporates a 1-second (0.65 -second in the Improved seat) delay initiator to provide automatic opening of the belt during ejection. Use of the automatic-opening feature of the belt decreases seat separation and parachute deployment time, which reduces the altitude required for safe ejection. The buckle on the left half of the belt incorporates a rotary latch mechanism consisting of a belt latch, lanyard latch, interlock device, and a serrated manual release handle spring-loaded to the locked position. The interlock device prevents fastening the belt without first attaching the automatic parachute arming lanyard into the lanyard latch. Actuation of the handle is not necessary when manually attaching the lanyard anchor and connecting the right half of the belt. Full counterclockwise rotation of the manual release handle releases the lanyard anchor and the belt link. See figure 1-69 for proper connection and operation.

EJECTION SEAT–IMPROVED

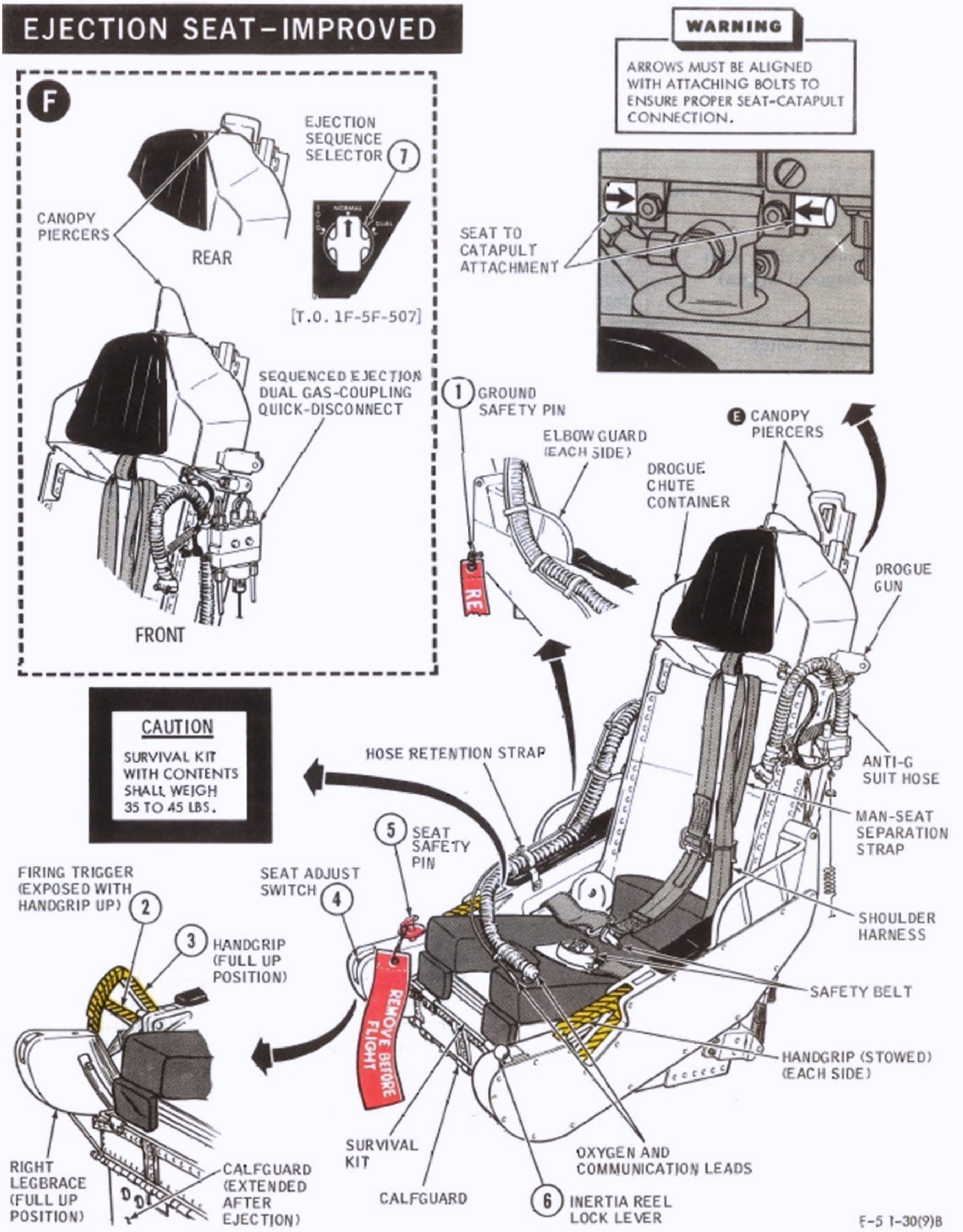


Figure 1-68.

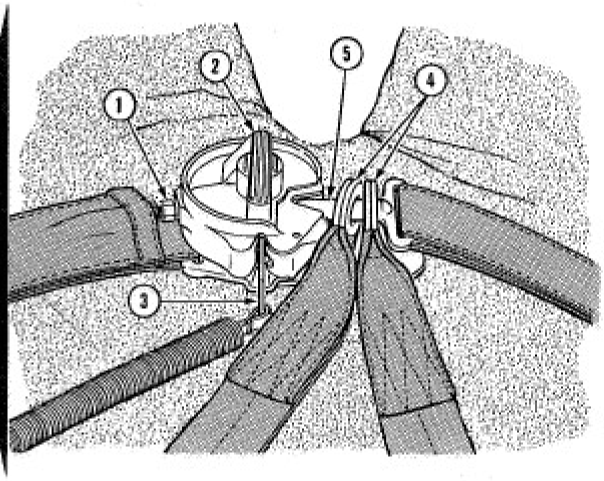
EJECTION SEAT —IMPROVED (Figure 1-68)

CONTROLS		FUNCTION
1	Ground Safety Pin	Provides mechanical safetying of the safety belt during ground maintenance.
2	Firing Triggers (Yellow with black stripes)	Squeezing either or both firing triggers initiates sequenced canopy jettison and seat ejection.
3	Handgrips (Yellow with black diagonal stripes)	Pulling either or both handgrips up to travel limits raises legbraces to fully up and locked position and exposes firing triggers. First 12 degrees of travel unlocks both legbraces.
4	Seat Adjust Switch	Forward and Hold — Lowers seat electrically. Center — Spring-loaded neutral position. Aft and Hold — Raises seat electrically.
5	Seat Safety Pin	Inserted — Holds right legbrace handgrip down. The streamer is attached to the canopy jettison handle safety pin streamer.
6	Inertia Reel Lock Lever	LOCK — Locks shoulder harness. AUTO — Unlocks shoulder harness, freeing it to reel in and out. Harness automatically locks during 3-g acceleration and during seat ejection.
7	Ⓕ EJECTION SEQUENCE SELECTOR (Rear Cockpit)	SOLO — No automatic ejection sequencing is provided. Each cockpit must eject independently. NORMAL — Ejection sequencing is automatic if the front cockpit initiates ejection. If ejection is initiated in the rear cockpit, each cockpit must eject independently. DUAL — Automatic ejection sequencing occurs when either cockpit initiates ejection. **NOTE** The shoulder harness in both cockpits will retract when the ejection sequence selector is set at NORMAL and the firing triggers in the front cockpit are squeezed or when the ejection sequence selector is set at DUAL and the firing triggers in either cockpit are squeezed. See EJECTION SEQUENCE paragraph this section.

AUTOMATIC OPENING SAFETY BELT HBU-2B/A

LOCKED

1. INITIATOR HOSE TO AUTOMATIC RELEASE MECHANISM.
2. MANUAL RELEASE HANDLE SPRING-LOADED TO LOCKED POSITION.
3. ANCHOR (GOLD KEY FROM AUTOMATIC PARACHUTE ARMING LANYARD) INSERTED AND LOCKED IN LANYARD LATCH.
4. SHOULDER HARNESS LOOPS OVER BELT LINK.
5. BELT LINK INSERTED AND LOCKED IN BELT LATCH.

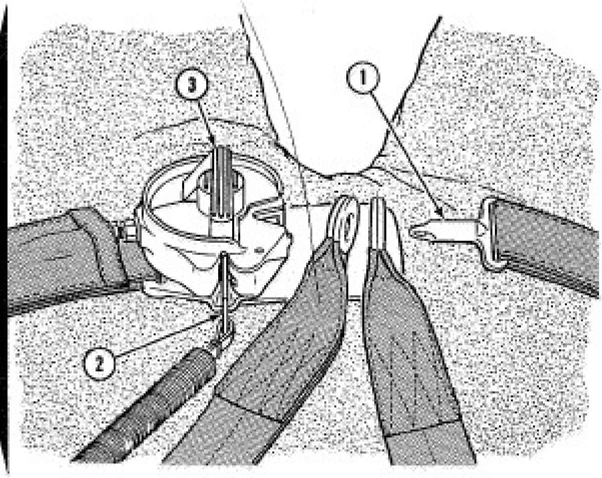


WARNING

- TO PREVENT INADVERTENT OPENING OF SAFETY BELT BY FULL AFT AND THEN LEFT MOVEMENT OF CONTROL STICK, CENTER SHOULDER HARNESS LOOPS ON TORSO, WHICH WILL OFFSET SAFETY BELT BUCKLE TO LEFT OF CENTER.
- LANYARD MUST BE OUTSIDE PARACHUTE HARNESS AND NOT FOULED ON ANY EQUIPMENT, TO PERMIT CLEAN SEPARATION FROM SEAT.
- ANCHOR (GOLD KEY) MUST BE INSERTED AND LOCKED BEFORE ATTEMPTING TO LOCK BELT LATCH. GIVE LANYARD SEVERAL YANKS TO INSURE THAT ANCHOR IS SECURED.

AUTOMATICALLY OPENED

1. AUTOMATIC RELEASE MECHANISM ACTUATED BY GAS PRESSURE FROM INITIATOR; BELT LINK AUTOMATICALLY RELEASED.
2. ANCHOR RETAINED IN LANYARD LATCH.
3. MANUAL RELEASE HANDLE DOES NOT ROTATE.



MANUALLY OPENED

1. MANUAL RELEASE HANDLE ROTATED FULLY COUNTERCLOCKWISE.

WARNING

UNDER NO CIRCUMSTANCES SHOULD THE SAFETY BELT BE MANUALLY OPENED BEFORE EJECTION, REGARDLESS OF THE ALTITUDE.

2. ANCHOR RELEASED FROM LANYARD LATCH.
3. BELT LINK RELEASED FROM BELT LATCH.

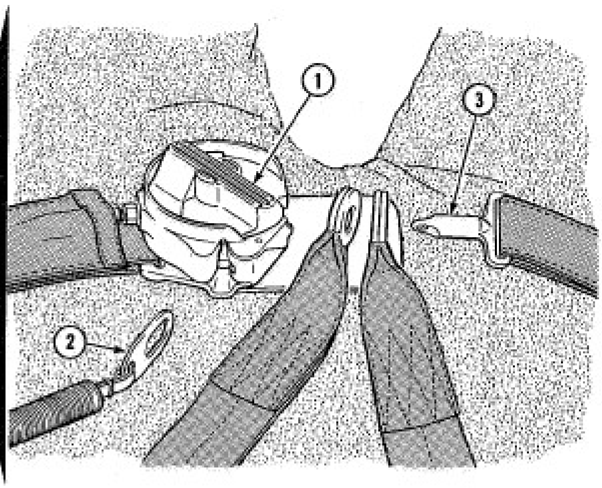


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Figure 1-69.

MAN-SEAT SEPARATOR

The man-seat separator is an inverted Y-shaped web strap assembly routed along the back of the ejection seat. The upper end of the strap is attached to a gas-operated ballistic reel behind the headrest, and the lower ends of the straps are routed under the survival kit and attached to the forward edge of the seat bucket. During ejection, high pressure gas from the safety belt initiator activates the ballistic reel, which draws the web straps taut, forcing the survival kit and pilot to separate from the seat.

ANTI-G SUIT HOSE

The anti-G suit hose on the left side of the seat next to the headrest (figures 1-67 and 1-68) is held in the stowed position by a flexible spring. A spring-loaded dust cover on the end of the hose must be opened to insert the anti-G suit hose connector.

EJECTION SEQUENCE SELECTOR Ⓕ

The ejection sequencer selector on the rear cockpit pedestal (figure 1-68) is a three position selector valve having SOLO, NORMAL, and DUAL positions. With the sequence selector positioned at SOLO, no automatic ejection sequence is provided. The ejection must be initiated separately for each seat. With the selector positioned at NORMAL, ejection sequence is determined by the crewmember initiating the ejection. With the selector positioned at DUAL, if ejection is initiated in either cockpit, both seats will eject, rear seat first.

PARACHUTE

BA-22

The BA-22 parachute is an automatic-opening parachute equipped with an aneroid device incorporating a 1-second delay timer connected to a parachute arming lanyard, and a zero-delay lanyard with hook. Connecting the parachute arming lanyard to the automatic-opening safety belt with the zero-delay lanyard hooked to the parachute ripcord handle provides the connection between the safety belt and the parachute ripcord (figure 1-70). The BA-22 parachute is used with the Standard seat.

BA-25A

The BA-25A parachute is an automatic-opening parachute equipped with an aneroid device incorporating a 0.25-second delay timer connected to a parachute arming lanyard (figure 1-70). The BA-25A parachute is used with the Improved seat.

PERSONAL EQUIPMENT CONNECTIONS

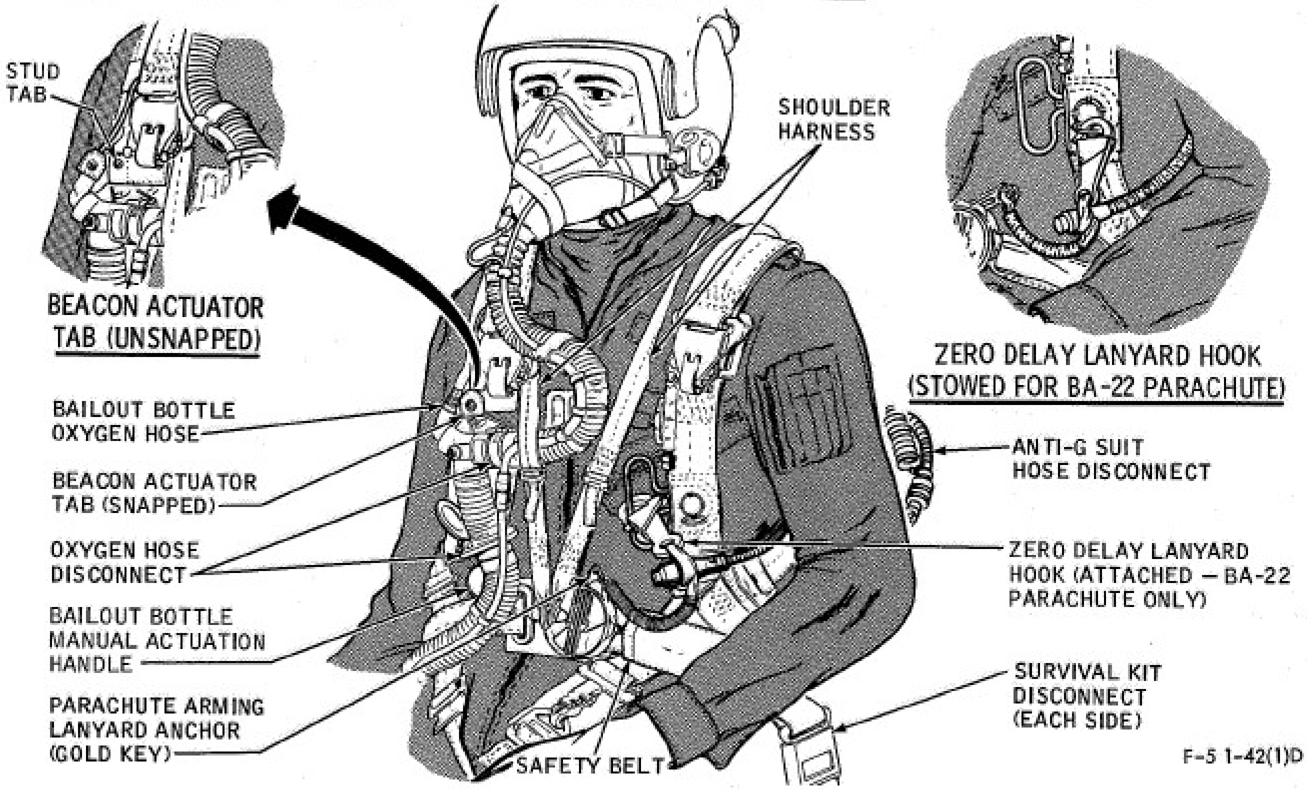


Figure 1-70.

PERSONNEL LOCATOR BEACON

A personnel locator beacon in the parachute harness, if installed, is used to locate a pilot who has ejected. The beacon transmits a signal on 243.0 MHz. Upon parachute deployment, the beacon will operate automatically when the actuator tab is snapped to the stud tab on the right main lift web of the harness (figure 1-70).

EJECTION SEQUENCE Ⓔ

Standard Seat

Canopy jettison followed by seat ejection is initiated by raising handgrips. This action exposes the catapult firing triggers and automatically locks the shoulder harness inertial reel. Squeezing either or both triggers jettisons the canopy, and seat ejection occurs 0.3 second later. Accompanying this action, the seat adjuster power cable and personal leads are disconnected, the calfguard is lowered into position, and the automatic safety belt 1-second delay initiator is activated. Following the 1-second delay the initiator fires; subsequent pressure buildup opens the safety belt and also actuates the man-seat separator, forcing the crewmember from the ejection seat. The open safety belt releases the shoulder harness straps but retains the parachute arming lanyard. With the zero delay lanyard hook stowed, the parachute arming lanyard arms the parachute aneroid and timer device as the crewmember separates from the seat. Above a preset altitude, the aneroid will delay automatic opening of the parachute until the crewmember free falls to the preset altitude. At or below the preset altitude, only the timer function is required to deploy the parachute. With the zero delay lanyard hook attached to the parachute ripcord handle, the parachute arming lanyard and zero-delay lanyard pull the parachute ripcord. See section II for proper connection of the zero-delay lanyard and to section III for the proper use of ejection equipment.

WARNING

The zero-delay lanyard must be disconnected and stowed when operating at high altitudes to permit the automatic parachute aneroid and timer to function.

Improved Seat

The Improved seat ejection sequence functions in basically the same manner as the Standard seat, except that the automatic safety belt 0.65-second delay initiator is activated during seat/aircraft separation. After the seat has left the cockpit, the drogue chute deploys to stabilize the seat, and the safety belt initiator fires, opening the safety belt and actuating the man-seat separator. As the crewmember separates from the seat, the parachute arming lanyard arms the parachute aneroid and timer device. Above a preset altitude, the aneroid will delay automatic opening of the parachute until the crewmember free-falls to the preset altitude. At or below the preset altitude, only the timer function is required to deploy the parachute. See section III for the proper use of the ejection equipment.

EJECTION SEQUENCE Ⓕ

Seat ejection sequence is determined by the position of the ejection sequence selector and whether the ejection is initiated in the front or rear cockpit.

Selector At SOLO

Raising the handgrips and squeezing either or both firing triggers jettisons that cockpit's canopy and retracts the shoulder harness on that ejection seat. The seat will eject 0.3 second after firing trigger is squeezed. With SOLO selected, when there are two crewmembers in the aircraft, the occupant of the rear cockpit shoud eject first. The occupant of the front cockpit should initiate ejection 1 second after rear seat ejection.

Selector At NORMAL

If the ejection procedure is initiated in the front cockpit, by raising the handgrips and squeezing the firing trigger(s), the rear cockpit canopy will be jettisoned and the shoulder harness will retract; 0.3 second later, the rear seat will eject. The front cockpit canopy will be jettisoned and the shoulder harness of the front section seat will retract 0.45 second after rear seat ejects (i.e., 0.3 + 0.45 equals 0.75 second time delay). The front cockpit seat ejects 0.3 second after shoulder harness retracts (total time equals 1.05 seconds). If the ejection is initiated in the rear cockpit, only that seat will be affected, no jettison/ejection activity will occur in front cockpit until initiated by that crewmember.

Selector At DUAL

If the ejection procedure is initiated in either cockpit by raising the handgrips and squeezing the firing trigger(s), the rear cockpit canopy will be jettisoned and the shoulder harness will retract; 0.3 second later, the rear seat will eject. The front cockpit canopy will be jettisoned and the shoulder harness of the front ejection seat will retract 0.45 second after rear seat ejects. The front cockpit seat ejects 0.3 second after shoulder harness retracts.

Seat Ejection

When ejection occurs, the seat adjuster power cable, the personal leads, and the sequenced ejection dual gas-coupling are disconnected, the calfguard is lowered into position, and the automatic safety belt 0.65-second delay initiator is activated. After the seat leaves the cockpit, the drogue chute deploys to stabilize the seat, and the safety belt initiator fires, opening the safety belt and actuating the man-seat separator. The open safety belt releases the shoulder harness straps but retains the parachute arming lanyard. The man-seat separator strap assembly is drawn taut, separating the crewmember from the seat. As the crewmember separates from the seat, the parachute arming lanyard arms the parachute aneroid and timer device. Above a preset altitude, the aneroid will delay automatic opening of the parachute until the crewmember free-falls to the preset altitude. At or below the preset altitude, only the timer function is required to deploy the parachute. See section III for proper use of ejection equipment.

SURVIVAL KIT

Standard

The survival kit (figure 1-67) fits in the ejection seat and is attached to the parachute harness by web straps and quick-disconnect buckles. The upper surface of the hinged lid on the forward section is equipped with a seat cushion. The cushion has a front center cutout that assures full aft control stick travel. The survival kit lanyard attaches to the parachute harness. The rear of the kit provides support for the back-type parachute. The contents within the kit may be varied, dependent upon local command desires and environmental requirements, and may include a life raft. The life raft, attached to the lanyard, contains a CO_2 bottle for inflation. After ejection from the aircraft, the survival kit is deployed during parachute descent by pulling the yellow emergency handle on the right side of the kit.

Pulling the handle up and backward will release the kit from the parachute harness, the kit will open, and the life raft will be deployed and automatically inflated when the survival kit lanyard reaches full length. When deployed, the raft will be suspended below the pilot, attached to the lanyard. For emergency ground egress, pulling the yellow emergency handle, with pilot's weight on seat, will release the kit from the parachute harness. The lanyard attachment to the kit will be disconnected to prevent inadvertent deployment and pilot entanglement when egress is accomplished with the parachute harness fastened. Normal egress from the cockpit should be accomplished by manually disconnecting the two quick-disconnect buckles from the parachute harness.

Improved

The survival kit (figure 1-71) fits on the ejection seat and is attached to the parachute harness by two quick-disconnect buckle/web strap assemblies. The forward section of the kit top is equipped with a seat cushion. The rear section of the kit top provides support for a back type parachute. Depending upon local command desires, kit contents will vary and may include a life raft.

AUTOMATIC/MANUAL DEPLOYMENT

The kit will be automatically released during the ejection sequence or retained for manual release, depending upon the selected position of the survival kit AUTO/MANUAL selector before ejection. During parachute deployment, the parachute shroud lines pull the kit auto-release cable. If the AUTO/MANUAL selector is at AUTO, the kit auto-release cable pull will cause an initiator cartridge to fire, and after a 4-second delay, the survival kit is automatically released. If the selector is at MANUAL, the cartridge is safetied and the kit must then be released manually by pulling the emergency release handle. When the kit is released, either automatically or manually, the quick-disconnect buckle/web assemblies separate from the kit, permitting it to open and fall away from the crewmember until the lanyard, attached to the parachute harness, is fully extended. The life raft, if included in the kit, will be automatically deployed and inflated.

EMERGENCY AND NORMAL GROUND EGRESS

During emergency ground egress, pulling the emergency release handle will release the survival kit from the parachute harness regardless of the position of the AUTO/MANUAL selector.

NOTE

> Pilot's weight must be on survival kit while pulling the emergency release handle. If the handle is pulled without pilot's weight on kit, the lanyard will remain attached to the parachute harness and could cause egress difficulties.

Normal egress should be accomplished by manually disconnecting both quick-disconnect buckle/web strap assemblies from the parachute harness.

SURVIVAL KIT

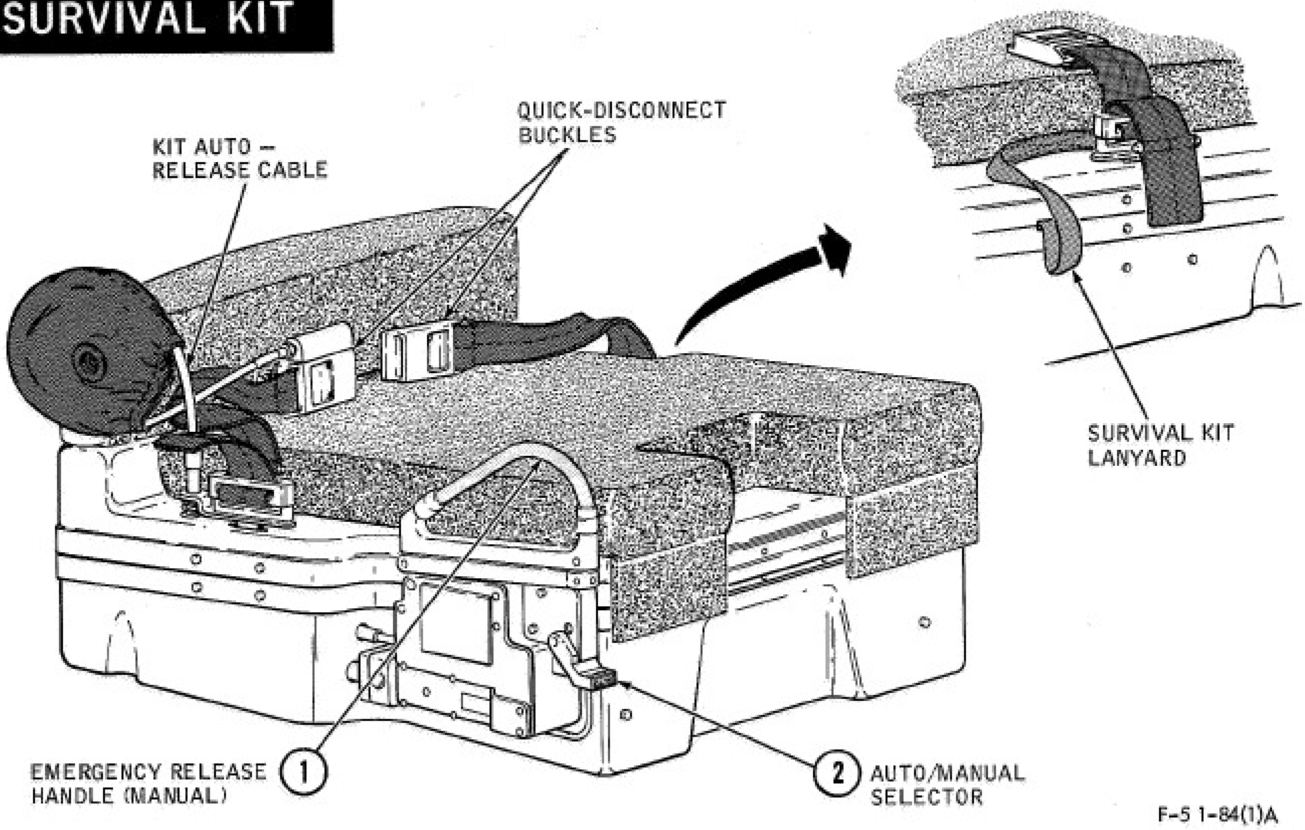


Figure 1-71.

SURVIVAL KIT (IMPROVED) (Figure 1-71)

CONTROLS	FUNCTION
1 Emergency Release Handle	Pull —a. After ejection, with AUTO/MANUAL selector at MANUAL; releases kit. b. While seated on survival kit, regardless of the position of the AUTO/MANUAL selector; releases both quick-disconnects from kit.
2 AUTO/MANUAL Selector	AUTO (Up) —Permits automatic deployment of survival kit 4 seconds after parachute shroud lines are fully stretched. MANUAL (Down) —Permits manual deployment of survival kit when emergency release handle is pulled.

ENVIRONMENTAL CONTROL SYSTEM

The environmental control system consists of the following: air-conditioning, pressurization, canopy and windshield defog, anti-g, air distribution systems, and windshield rain removal (Ⓔ only). All systems except anti-g suit, canopy and windshield seal system, hydraulic reservoirs, external fuel tanks, and radar waveguide pressurization are controlled by controls on the right vertical panel (Ⓕ front cockpit) (figures 1-15 thru 1-19), and the two adjustable/rotatable torso outlets forward on the left canopy duct above the canopy rail (Ⓔ only) (figures 1-3 and 1-6). Air from the ninth stage of the compressor section of each engine is used to perform cooling, heating, conditioning, and pressurization functions. Either engine will provide sufficient air to operate the system in the event of engine failure. Check valves prevent air bleedoff to an inoperative engine. See figure 1-72, sheets 1 and 2 for flow diagram.

ENVIRONMENTAL CONTROL SYSTEM

E EXCEPT E-1

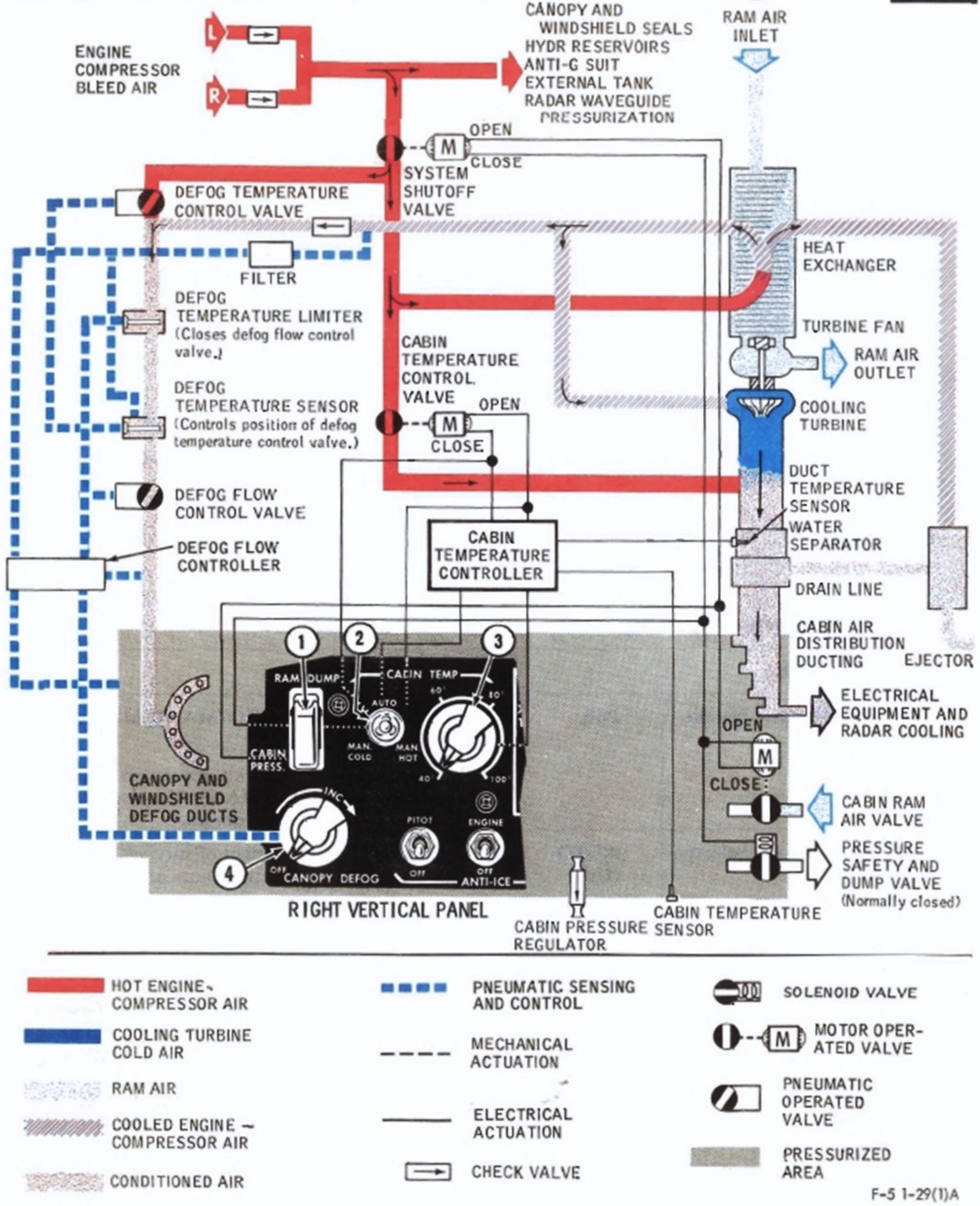


Figure 1-72 (Sheet 1).

ENVIRONMENTAL CONTROL SYSTEM

F E-1

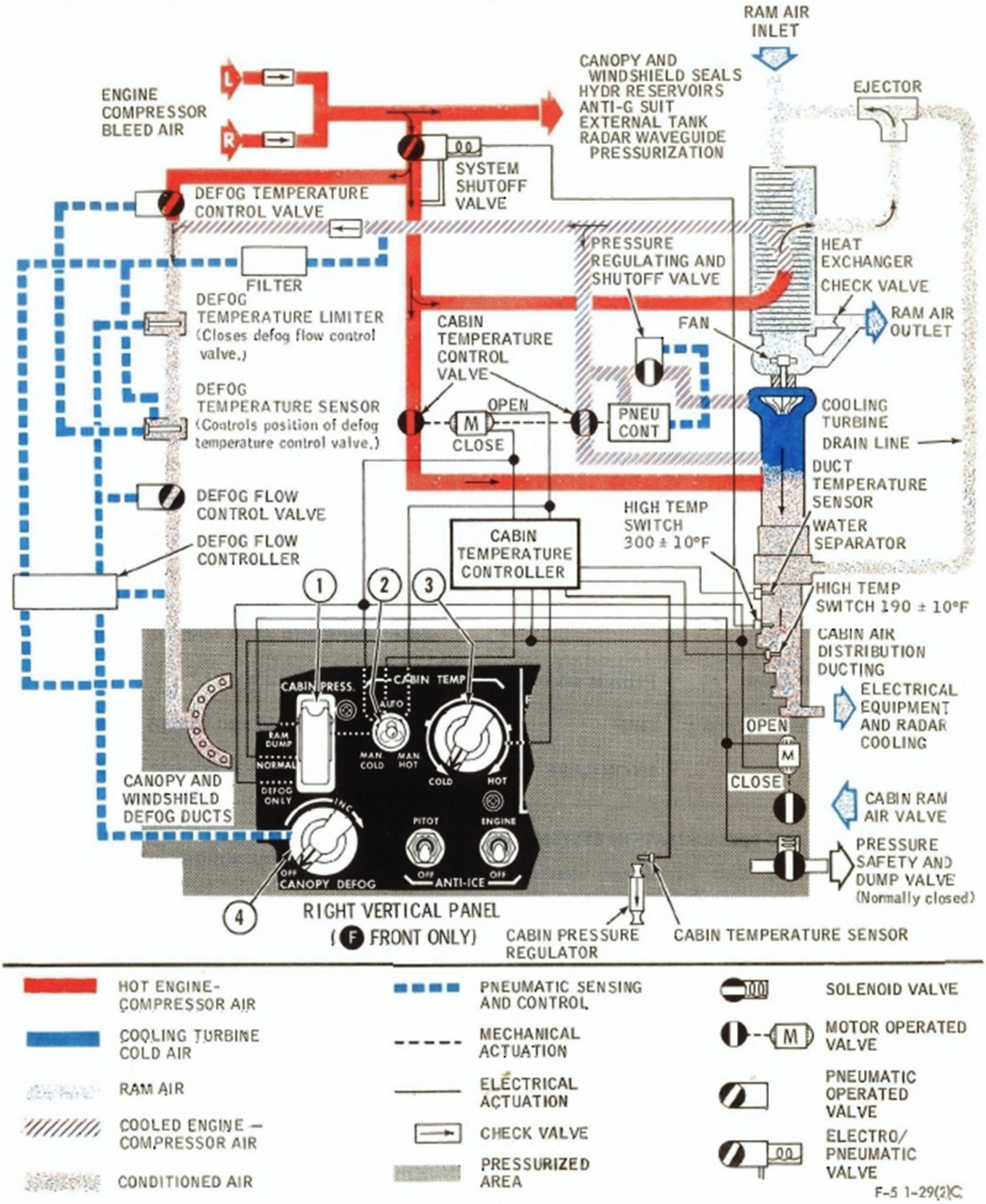


Figure 1-72 (Sheet 2).

ENVIRONMENTAL CONTROL SYSTEM CONTROLS (Figure 1-72)

CONTROLS	FUNCTION	
1 CABIN PRESS Switch (Guarded)	RAM DUMP	— Allows ram air to enter cockpit (Ⓕ both cockpits) and avionics equipment bay thru the air distribution system.
	CABIN PRESS. (Ⓔ EXCEPT [E-1])	— (Guard Closed) Allows cockpit to be pressurized.
	NORMAL (Ⓕ [E-1])	— (Guard Closed) Activates system to pressurize and air-condition cockpit.
	DEFOG ONLY (Ⓕ [E-1])	— a. Shuts off all air except defog. b. Shuts off cockpit control of inlet air temperature.
2 CABIN TEMP Switch	AUTO	— Automatically maintains cockpit temperature selected by CABIN TEMP knob.
	Center (Neutral)	— Locks bypass valve in the position held at time of switch actuation.
	MAN COLD	— Cockpit air supply temperature will decrease until full cold is reached.
	MAN HOT	— Cockpit air supply temperature will increase until full hot is reached. **NOTE** When actuating switch, pause momentarily at center position to allow relay to function.
3 CABIN TEMP Knob	Permits selection of cockpit inlet temperature.	
4 CANOPY DEFOG Knob	OFF	— Shuts off the windshield and canopy defog air.
	INCREASE	— Activates system to control amount of airflow thru defog flow control valve.

AIR-CONDITIONING AND PRESSURIZATION SYSTEMS

Air is routed thru a heat exchanger, cooling turbine, and water separator before entering the cockpit area. Cockpit temperature is automatically or manually selected by a temperature switch. In the automatic mode, a temperature control valve automatically maintains the temperature level selected by the temperature knob. In manual mode, the temperature controller is inactive and temperature is controlled by manual operation of the temperature switch until desired temperature is achieved. Manual mode should be used only if a malfunction occurs in automatic mode. A pressure regulator automatically maintains the cockpit pressure differential schedule illustrated in figure 1-73. Cockpit pressure altitude is indicated on the cabin pressure altimeter on the left console (Ⓕ front cockpit). Static pressure ports on each side of the fuselage below the windshield area provide a static air pressure source reference to the regulator and safety valve for ambient atmospheric conditions. A pressure safety valve incorporated in the system automatically protects the cockpit(s) from excessive high or low pressure. Pressurizing air is supplied to the external tank system, anti-g suit system, canopy and windshield seal system, hydraulic reservoirs and radar waveguide.

CANOPY AND WINDSHIELD DEFOGGING

The canopy and windshield are defogged by a mixture of bleed air and partially cooled package heat exchanger air that is directed thru ducting to the canopy and windshield surfaces to prevent fogging. Defogging air temperature is independent of the temperature selected by the cockpit temperature knob, but is maintained within temperature limits by the defog temperature control valve and the defog temperature sensor.

ANTI-G SUIT

Anti-G suit air pressure is routed thru a regulating valve to the anti-G suit. A flexible hose from the regulating valve to the anti-G suit passes thru a quick-disconnect fitting on the upper left side of the ejection seat to allow automatic disconnection upon ejection. The anti-G suit valve is on the left floor aft of the seat (figures 1-3 thru 1-8). The valve regulates air pressure to the anti-G suit to inflate the suit when positive G is encountered. The valve operates automatically and begins to function at about 1.75G, exerting an increasing pressure as the G-load is increased. When the acceleration decreases below the valve opening G-setting, the valve closes and the suit deflates.

AIR DISTRIBUTION Ⓔ

The cockpit air distribution subsystem provides distribution of air-conditioning and pressurization airflow and routes cooling air to the two torso outlets in the left forward corner of the cockpit above the canopy rail. Airflow volume of the outlets can be adjusted or shut off by turning the outer opening. The torso outlets can also be adjusted directionally by tilting the outlet left-right or up-down. In addition, a floor outlet on the right side of the seat provides airflow to supplement the flow from the torso outlets. In an emergency, the pilot can shut down the cabin conditioning and pressurization system by selecting the RAM DUMP position of the CABIN PRESS switch. The RAM DUMP position fully opens the pressure safety valve, and opens a small ram air door on the left side of the cockpit, providing ventilating air to the pilot, and closes the air-conditioning system shutoff valve.

NOTE

The ram air door can be opened at any airspeed but cannot be closed at airspeeds above 400 KIAS.

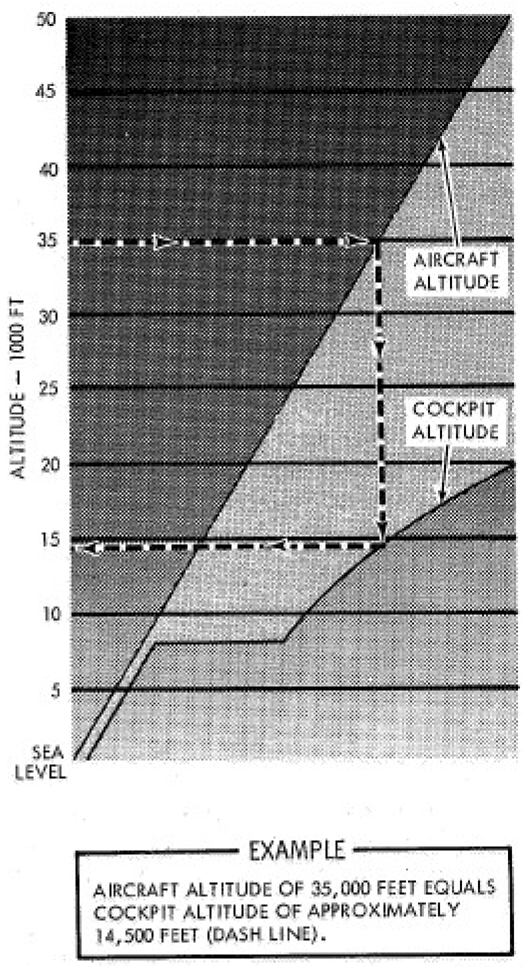
AIR DISTRIBUTION Ⓕ

The cockpit air distribution subsystem provides routing of the air-conditioning and pressurization airflow. Conditioned air is delivered to each cockpit thru torso outlets on the right vertical panel and the left canopy rail. Airflow can be adjusted or shut off by rotating and/or turning torso outlets. Floor outlets at the forward end of the left and right consoles provide conditioned air to the foot area of the cockpits and are stationary and permanently open. Ram air entering the distribution system thru the ram air duct is supplied to the cabin outlets whenever the cockpit pressurization switch is positioned to RAM DUMP. This position electrically opens the cabin ram air valve and closes the system shutoff valve. A ram air valve in the forward avionics bay opens to provide cooling air as cabin air is discharged overboard thru the safety valve. This valve also automatically opens to supply cooling air whenever the aircraft is at or above an altitude of 40,000 feet.

ELECTRICAL/ELECTRONIC EQUIPMENT CONDITIONING

On ground, two ac-powered blowers circulate ambient air within the forward avionics bay when electrical power is on. When the canopy is closed, conditioned air from the cockpit area is discharged thru the cabin pressure regulator to the forward avionics bay. This conditioning maintains temperature limits in flight. The aft electrical bay is cooled by circulating conditioned air.

COCKPIT PRESSURIZATION SCHEDULE



F-5 1-43(1)A

Figure 1-73.

WINDSHIELD RAIN REMOVAL SYSTEM Ⓔ

The windshield rain removal system is provided to improve forward visibility in rain. The system consists of a rain removal switch outboard of the throttles (figure 1-21), windshield spray nozzles at the exterior base of the windshield, a pressurized rain repellent fluid container, timer, and solenoid valve in the nose compartment, and a system pressure gage in the nosewheel well.

SYSTEM OPERATION

Holding the rain removal switch momentarily at RAIN REMOVAL will provide approximately 1/2 second of system operation. Rain repellent fluid will squirt from the nozzles at the base of the windshield and react with the rain, spreading a transparent water-repellent film over the face of the windshield. One 1/2-second application will last approximately 10 minutes. More than one application may be required initially if windshield is dirty or rain intensity is excessive; thereafter, application is made as necessary to maintain clear visibility. Rewetting will start to occur at the lower outer corners of the windshield. If the rewetted area is allowed to advance toward the center of the windshield, subsequent application of rain repellent fluid may not allow reclearing of the rewetted area. Applications of fluid should be repeated as necessary to prevent the rewetted area from advancing toward the center of the windshield.

NOTE

- Inadvertent application of fluid to a dry windshield or during light rain and prolonged use of the system will cause cloudy residue to build up on portions of the windshield.
- A Form 781 entry is required each time system is used.

ANTI-ICING SYSTEMS

ENGINE ANTI-ICE

The engine anti-ice system directs engine ninth-stage compressor hot air to the engine inlet guide vanes (IGV), T_2 sensor, and the bullet nose of each engine. An electrically controlled engine anti-ice valve controls the flow of hot air to each engine. Both anti-ice valves are activated by an anti-ice switch on the right vertical panel (Ⓕ front cockpit) (figures 1-15 thru 1-19) and actuated by engine compressor discharge pressure. The switch has two positions: ENGINE and OFF. A caution light placarded ENGINE ANTI-ICE ON on the caution light panel illuminates when the switch is at ENGINE.

System Operation

The engine anti-ice valves are normally closed until electrically energized and sufficient air pressure is received from the engine to open them. The valves open when the engine anti-ice switch is positioned to ENGINE. At high engine rpm, (below T_5 modulation), a slight increase in egt can be expected when the system is operating. Thrust loss during system operation is approximately 9% at MIL power and 6.5% at MAX power. At MIL power, the opening of the anti-ice valve may produce an approximate 100 lb/hr decrease in fuel flow and a 2% increase in nozzle opening indication. The engine anti-ice valve will fail to the closed position if dc power is lost.

NOTE

To check engine anti-ice system operation prior to flight, with throttle at 75% rpm, position ENGINE ANTI-ICE switch to ENGINE, and check for a slight rise in egt. Also check that ENGINE ANTI-ICE ON caution light comes on when switch is actuated.

PITOT BOOM, TOTAL TEMPERATURE PROBE, AND AOA VANE ANTI-ICING

The pitot boom, total temperature probe, and AOA vane contain electric heating elements for anti-icing. The pitot heater is powered by the right ac bus; the AOA vane and total temperature probe elements are powered by the left ac bus. Positioning the two-position pitot anti-ice switch on the right vertical panel (Ⓕ front cockpit) (figure 1-72) to PITOT activates all heating elements.

AIRCRAFT WEAPONS SYSTEM

For detailed description and operation of fire control radar, lead-computing optical sight, sight camera, gun and missile systems; and armament controls for firing and/or release of guns, missiles, bombs, and rockets refer to the Aircrew Nonnuclear Weapons Delivery Manual, T.O. 1F-5E-34-1-1. See Jettison System, this section, for description and operation of stores jettison controls. See section V for authorized store configurations and limitations.

TOW TARGET SYSTEM (DART)

The A/A37U-15 (Dart) tow target system can be carried for aerial gunnery. The system consists of an RMU-10/A tow reel pod on the centerline pylon and an adapter and launcher assembly on the left outboard pylon to carry, launch, and tow a TDU-10/B Dart target. A nylon rope is routed under the aft fuselage and the left horizontal stabilizer. The rope and backup cable are suspended forward to the target and attached to the aircraft with cloth tape. Armament circuitry and switches provide controls for launching, towing, and freeing the target. A cable cutter in the tow reel can be electrically actuated to cut the tow cable. The tow reel pod and target carrier are not jettisonable. See Section V for limitations and the appendix for performance.

TOW TARGET SYSTEM CONTROLS

Refer to T.O. 1F-5E-34-1-1 for operation of controls.

MISCELLANEOUS EQUIPMENT

INSTRUMENT HOOD (F)

The rear cockpit may be equipped with an instrument hood for simulated instrument training flights. The hood is positioned on guides and is stowed behind the ejection seat when not in use.

PHOTORECONNAISSANCE CAMERA SYSTEM [E-4]

The photoreconnaissance camera system is integrally mounted in the nose section (figure 1-74). The system consists of four KS-121A 70mm cameras, a computer-junction box, camera cooling and a camera window defog ducting, a camera control panel, and camera operate lights. The system provides high-resolution aerial photographic coverage of ground targets at a full range of speeds and at low to medium altitudes.

CAMERA COMPARTMENT ENVIRONMENTAL CONTROL SYSTEM

The camera compartment environmental control system (figure 1-75) controls the compartment temperature and directs defog air to the camera windows. The system draws cooling and defog air from the cockpit air-conditioning unit. The compartment is automatically cooled and the camera windows defogged when the cockpit air-conditioning system is operating and the camera mode selector is at TEST, RMT, or OPR. Temperature in the compartment is maintained between 80° and 90°F, except for occasional transients to 120°F on hot days at maximum airspeed, low-level missions.

CAMERA ARRANGEMENTS

The cameras may be arranged in six basic arrays, depending on specific target and mission requirements (figure 1-76, sheets 1 thru 6). Camera usage in the basic arrangements is dictated by scale, ground coverage, environment (hostile), and type of target. The arrangements provide two trimetrogon arrays, two split-vertical arrays, one oblique array, and one port array. Camera and lens usage is restricted to the six basic arrangements.

CAMERAS

The KS-121A camera is an aerial photographic sequential, pulse-operated still picture type with three alternate focal length lenses and shutter speeds of 1/250 to 1/4000 second, which are infinitely variable within that range. The film format is 70mm (2.25 inches) square. A light filter, integral light sensor, and a 200-foot film magazine with a capacity of 916 exposures are included. Lenses are 1.5-inch, 3-inch, and 6-inch focal length. Exposure is automatically controlled by the light sensor and AEC computer thru adjustment of lens aperture and shutter speed. Shutter speeds are automatically set by the automatic exposure control circuits. The shutter operates at 1/4000 second until the lens is completely open and then automatically adjusts down to the speed required, with 1/250 second the minimum shutter speed. Each camera is electrically connected to the computer-junction box. The computer-junction box and the cameras operate on 28-volt dc power. The computer-junction box controls and coordinates camera operation.

CAMERA CONTROL PANEL

The camera control panel (figure 1-74) has a camera selector switch for each camera, a mode selector, an interval selector, a built-in-test (BIT) button with GO and NO-GO lights, a camera override switch, and four frames-remaining counters with reset controls.

CAMERA OPERATE LIGHTS

A camera operate light for each camera on the instrument panel (figure 1-74) provides monitoring of camera operation head up. The green lights are numbered 1 thru 4 to correspond to cameras, camera selector switches, and frames-remaining counters. Each light comes on while the corresponding camera is operating. If the selected exposure interval is 1 second or less, the light will be on steady. If the interval exceeds 1 second, the light will pulse on with the camera for approximately 1 second each cycle.

VERTICAL STEREO—60 PERCENT OVERLAP COVERAGE

If vertical stereo coverage is required, use the Vertical Stereo—60 Percent Overlap Coverage chart (figure 1-77) as a guide. Vertical stereo coverage is vertical photographs of the same target area taken from slightly different angles. When the stereo (overlap) area is viewed thru special stereo viewing equipment, targets show vertical development permitting more effective analysis. Determine the size of the target and the scale required in the photography. Enter the chart with the scale and target size and determine first an altitude and lens focal length which will provide the required scale; second, the number of exposures required to cover the longest dimension of the target; and, third, the interval setting required between exposures at your planned groundspeed. The length of your flight line to cover the long dimension will be determined by the number of exposures required and the other dimension of the target will determine whether additional flight lines are required. Generally, a 20 percent side-overlap between flight lines is considered satisfactory.

STEREO COVERAGE OVERLAP

Stereo coverage requires 60 percent overlap from one exposure to the next, so that only 40 percent of each exposure is actual "ground advance." The intervals in figure 1-77 are based on the formula, so the intervals recommended will provide optimum stereo overlap coverage.

STEREO PLANNING SAMPLE PROBLEM

To provide stereo coverage of an industrial target area approximately 15,000 feet by 7000 feet at a desired scale of 1:10,000 go to figure 1-77. Determine that a 1.5-inch focal length lens at 1250 feet altitude, a 3-inch focal length length lens at 2500 feet altitude, or a 6-inch focal length lens at 5000 feet altitude will satisfy your scale requirements. Considering tactical and other requirements, you select the 6-inch lens. In the GROUND COVERAGE (SINGLE FRAME) column, you find that each exposure with this lens at this altitude will cover 1875 feet. With 60% overlap, each exposure will advance only 40% of the coverage, so that 1875 X .40 = 750 feet is the ground advance for each exposure. Dividing 750 into 15,000 (the longest dimension of the target) discloses that 20 exposures will cover the target lengthwise. Add 1 exposure at each end of each flight line to allow for turning error and lineup. Allowing 20% sidelap (side overlap) for each flight line (80% of 1875) discloses that each flight line covers 1500 feet across the target. Dividing 7500 by 1500 shows that 5 flight lines are required. Selecting 420 knots ground speed gives an INTVL-SEC switch setting of 1.0 second and the complete result is:

LENS	— 6.0-inch
ABSOLUTE ALTITUDE	— 5000 feet
INTVL-SEC Setting	— 1.0 second
EXP PER FLT LINES	— 22
NO. OF FLT LINES	— 5
TOTAL EXPOSURES	— 110

RECONNAISSANCE CAMERA SYSTEM

E-4

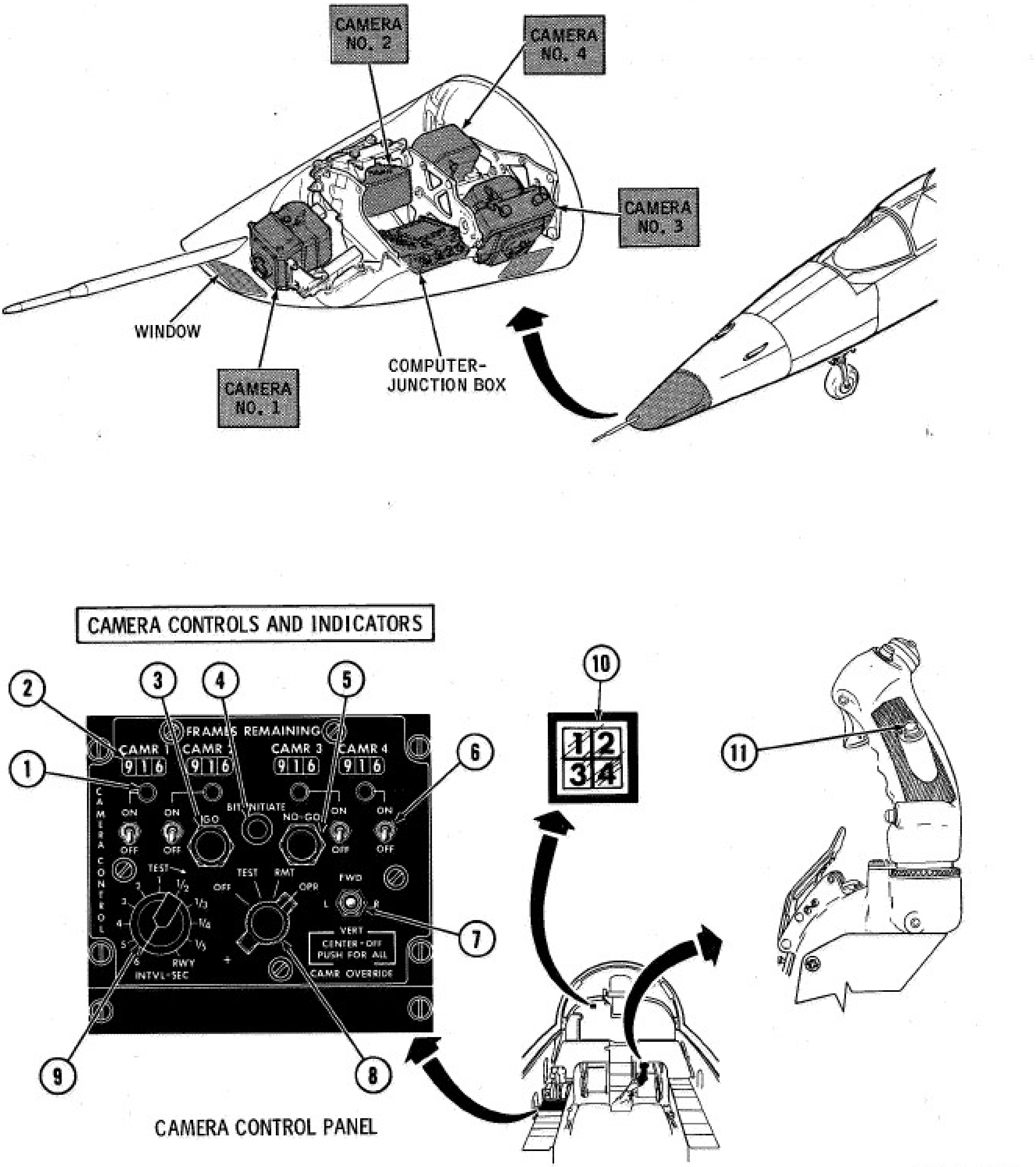


Figure 1-74.

RECON CAMERA SYSTEM (Figure 1-74)

CONTROLS AND INDICATORS		FUNCTION		
1	FRAMES REMAINING Reset Controls	Used to reset the FRAMES REMAINING readout when film magazine is refilled. Not used in flight.		
2	FRAMES REMAINING Counters	Readout	—	Number of frames (exposures) remaining in film magazine. When rotating, camera is operating.
3	GO Light	On	—	Camera BIT tested is operative.
4	BIT INITIATE Button (Momentary)	Push	—	Activates BIT test of selected camera with INTVL selector and mode select or at TEST. (A go indication is when each counter moves 3 to 5 frames and the GO light comes on after 4 seconds.)
5	NO-GO Light	On	—	Camera BIT tested is inoperative.
6	Camera Select Switches	OFF	—	Camera is not operating; dc power not available at camera.
		ON	—	Camera operates as controlled by mode selector and camera remote operate button or camera override switch.
7	CAMR OVERRIDE Switch	Overrides any position of mode selector and OFF position of camera select switches.		
		FWD	—	Operates camera No. 1.
		R	—	Operates camera No. 2.
		L	—	Operates camera No. 3
		VERT	—	Operates camera No. 4 (or 3 and 4).
		Center	—	Pushed in, operates all cameras.
8	Mode Selector	OFF	—	Power is off to all cameras.
		TEST	—	BIT circuits are selected.
		RMT	—	Transfers control of cameras to camera remote operate button (dogfight button) on stick grip.
		OPR	—	Operates cameras selected by camera select switches.
9	INTVL-SEC Switch	TEST 1	—	BIT interval circuits are selected.
		Numerical Values	—	Selects the placarded interval between exposures in seconds.
		RWY	—	Selects 6 exposures per second.
10	Camera Operate Lights (4)	On Steady	—	Corresponding camera is operating at an exposure interval of 1 second or less.
		On & Pulsing	—	(Approximately 1-second cycle) Corresponding camera is operating at an exposure interval greater than 1 second.
11	Camera Remote Operate Button	Press	—	Operates selected camera(s) with mode selector at RMT.

DEFINITIONS

ABSOLUTE ALTITUDE—Actual altitude above terrain (or water).

ARRAY—An arrangment of two or more cameras.

EXPOSURE (Frame)—One photograph, or shutter cycle, of a camera.

COVERAGE—Ground (or other) area covered by one frame or exposure.

LINES PER MILLIMETER—A measure of film quality which governs the resolution capability of the film.

NADIR—The point directly below the aircraft.

SCALE—The ratio of the photograph to the coverage, identical to the term as used in mapping.

PHOTO SCALE RECIPROCAL (PSR)—Denominator of the photo scale. Example photo scale—1:10,000 PSR—10,000.

OBLIQUE—A photograph taken at an angle other than vertical. High obliques include the horizon while low obliques do not.

VERTICAL—A photograph taken with the camera axis perpendicular to the terrain.

RESOLUTION—The capability of the system to photograph true images.

SPLIT-VERTICAL—Two cameras taking vertical photographs of an identical or overlapping area. Cameras may be angled obliquely to left and right with the overlapping coverage being the only portion which is vertical.

TRIMETROGON—A tri-camera array which gives horizon-to-horizon coverage with two oblique and one vertical camera.

PULSE-OPERATED CAMERA—An electrically actuated aerial camera in which actuation operates the shutter (exposes film) and advances the film.

STEREO—Overlapping verticals which, when viewed as stereo pairs with special equipment, give a three-dimensional effect which shows vertical development and characteristics in the overlap (stereo) area.

CAMERA ENVIRONMENTAL CONTROL SYSTEM — E-4

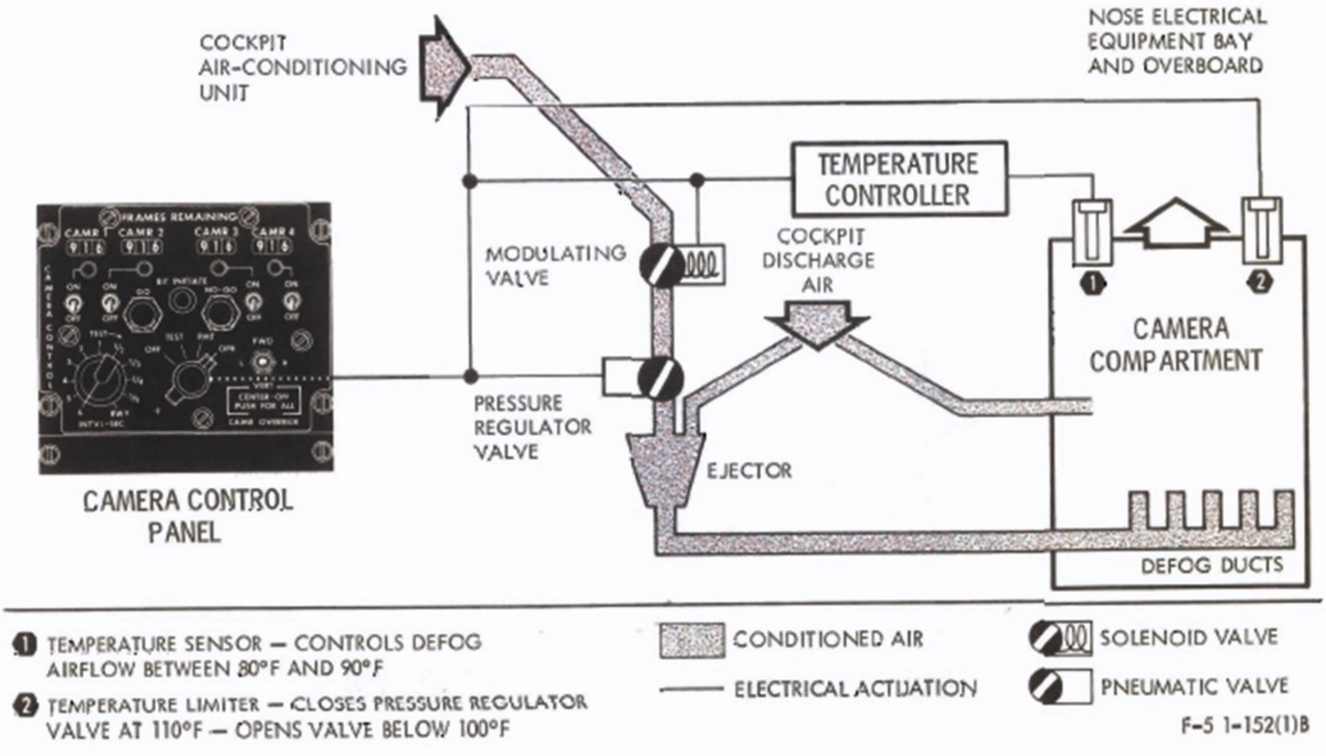


Figure 1-75.

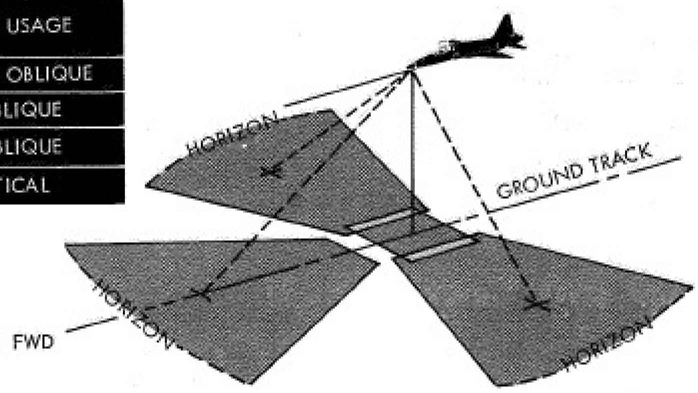
CAMERA AREA COVERAGE

ARRANGEMENT NO. 1

E-4

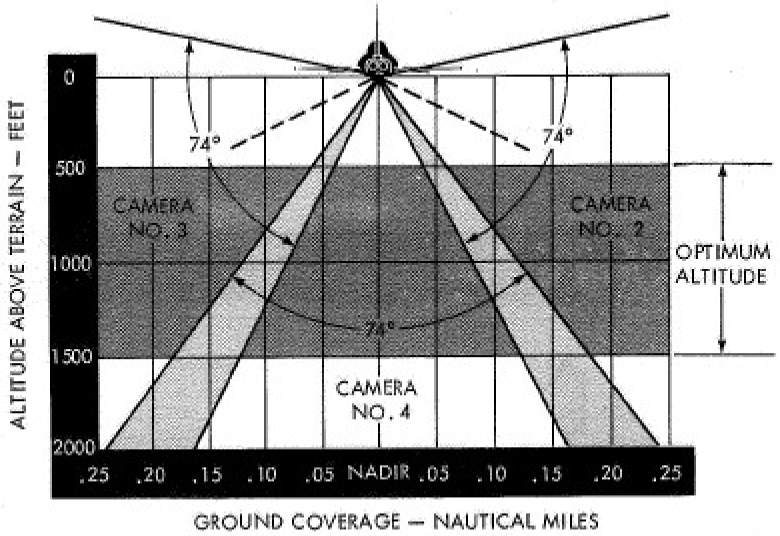
TRIMETROGON			
CAMERA NUMBER	FOCAL LENGTH — INCHES	DEPRESSION ANGLE — DEGREES	USAGE
1	3 OR 6	18	FWD OBLIQUE
2	1.5	26	R OBLIQUE
3	1.5	26	L OBLIQUE
4	1.5	90	VERTICAL

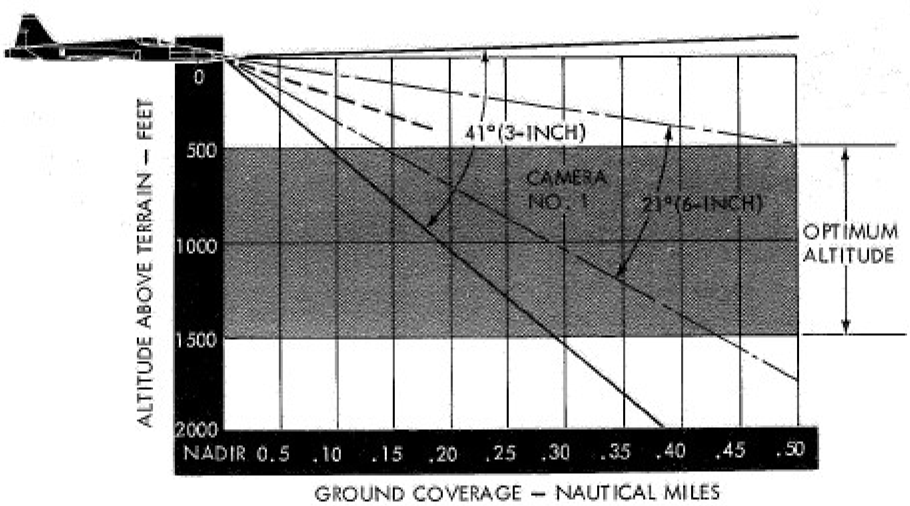
OPTIMUM ALTITUDE — 500 TO 1500 FEET



Note

SATISFACTORY COVERAGE FROM 100 TO 5000 FEET.





F-5 1-146(1)B

Figure 1-76 (Sheet 1).

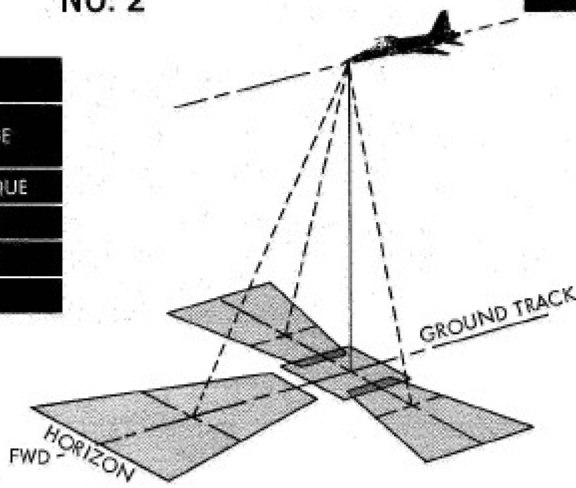
CAMERA AREA COVERAGE

ARRANGEMENT NO. 2

E-4

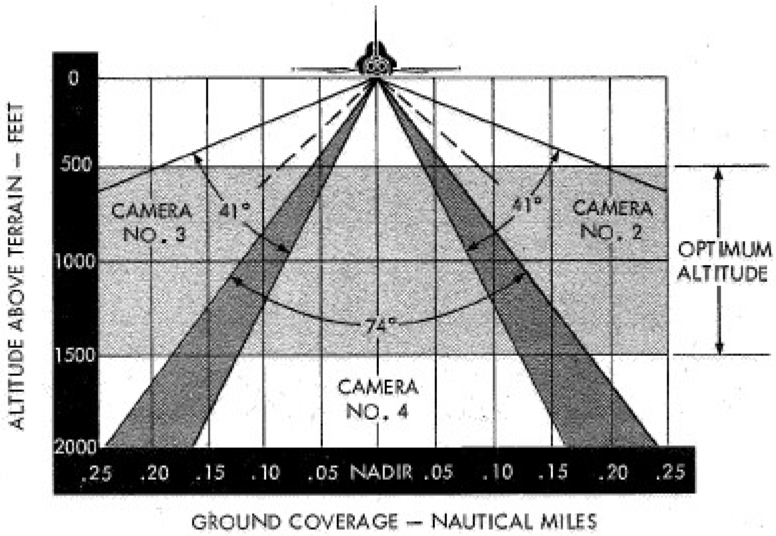
TRIMETROGON			
CAMERA NUMBER	FOCAL LENGTH — INCHES	DEPRESSION ANGLE — DEGREES	USAGE
1	3 OR 6	18	FWD OBLIQUE
2	3	41.5	R OBLIQUE
3	3	41.5	L OBLIQUE
4	1.5	90	VERTICAL

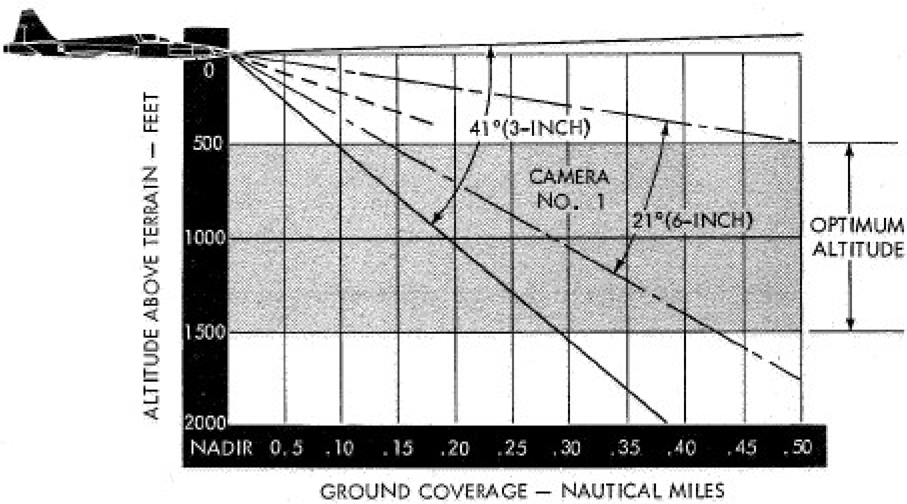
OPTIMUM ALTITUDE - 500 TO 1500 FEET



Note

SATISFACTORY COVERAGE FROM 100 TO 5000 FEET.



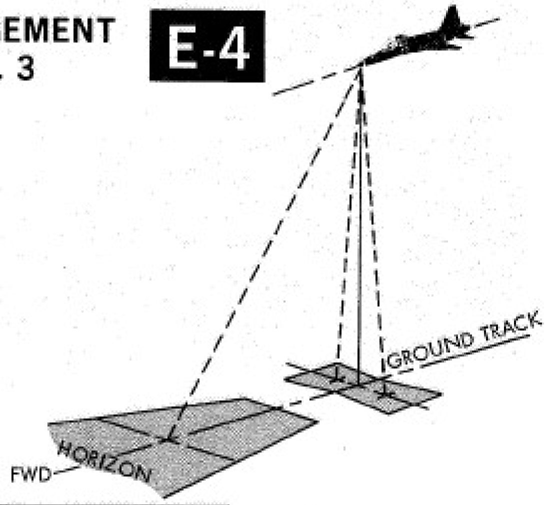


F-5 1-147(1)B

Figure 1-76 (Sheet 2).

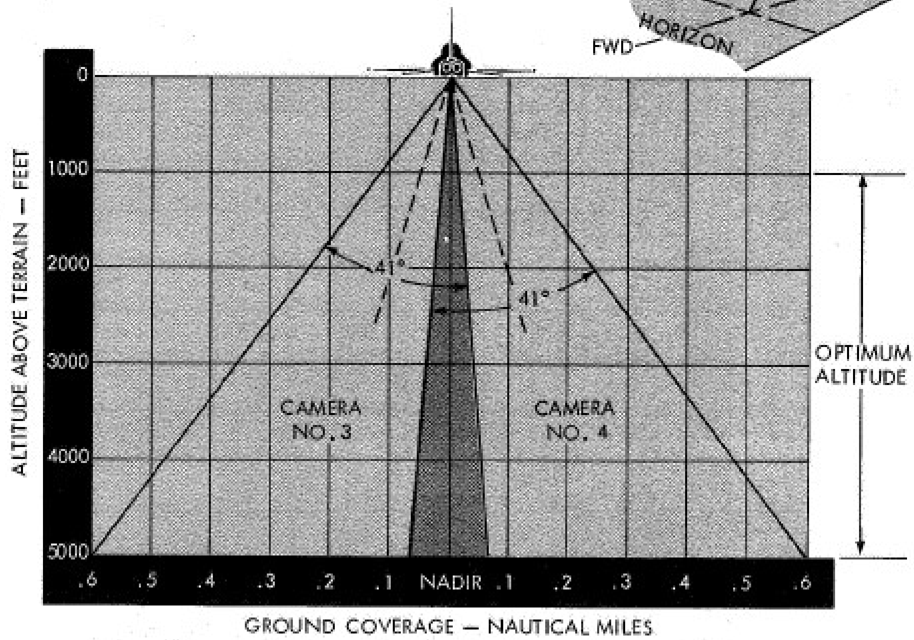
CAMERA AREA COVERAGE

ARRANGEMENT NO. 3 **E-4**



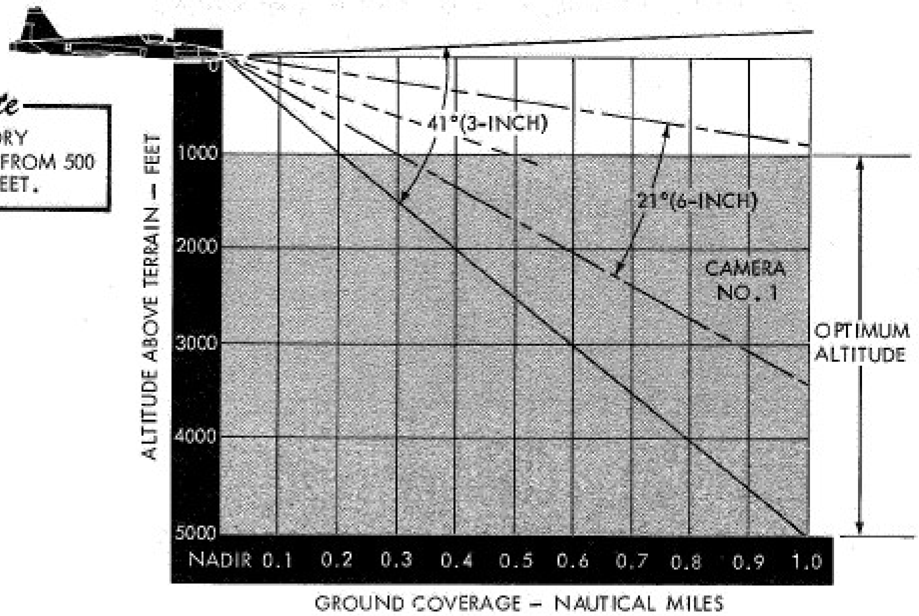
SPLIT VERTICAL			
CAMERA NUMBER	FOCAL LENGTH — INCHES	DEPRESSION ANGLE — DEGREES	USAGE
1	3 OR 6	18	FWD OBLIQUE
2	–	–	NOT USED
3	3	74	SPLIT VERTICAL
4	3	74	SPLIT VERTICAL

OPTIMUM ALTITUDE - 1000 TO 5000 FEET



Note

SATISFACTORY COVERAGE FROM 500 TO 20,000 FEET.



F-5 1-148(1)B

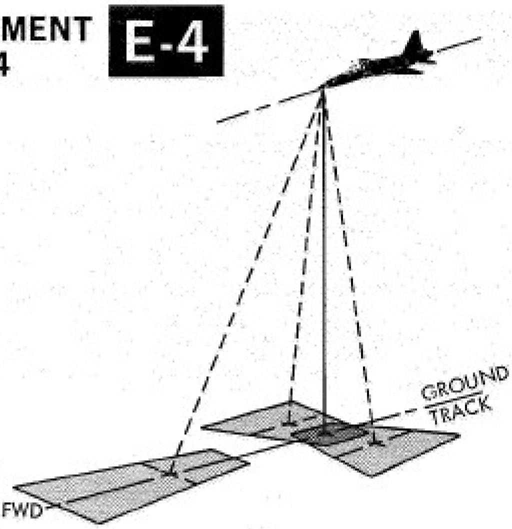
Figure 1-76 (Sheet 3).

CAMERA AREA COVERAGE

ARRANGEMENT NO. 4 E-4

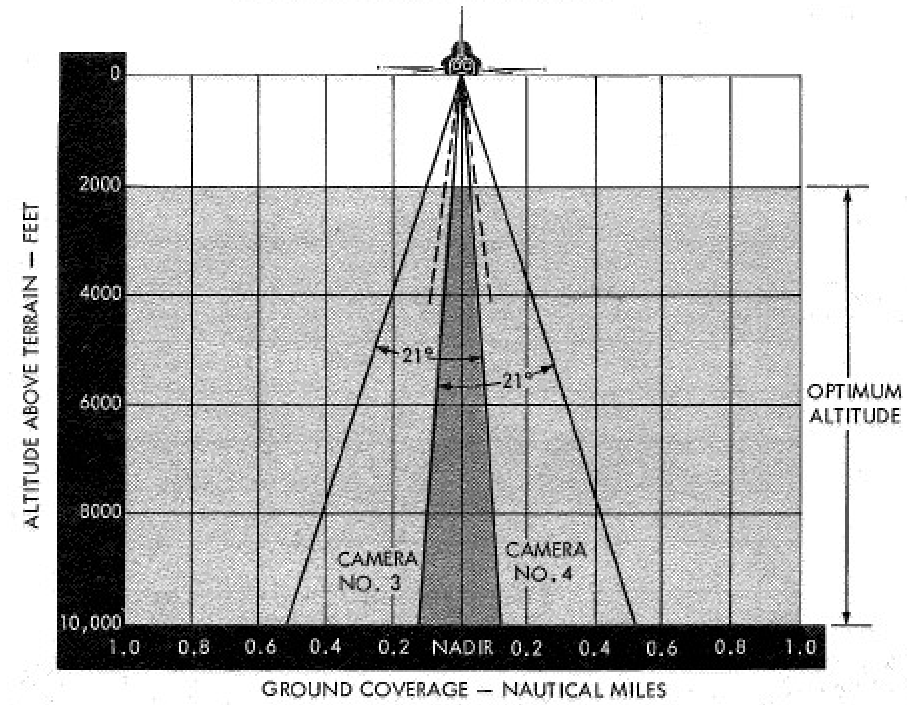
SPLIT VERTICAL			
CAMERA NUMBER	FOCAL LENGTH — INCHES	DEPRESSION ANGLE — DEGREES	USAGE
1	6	18	FWD OBLIQUE
2	—	—	NOT USED
3	6	81.5	SPLIT VERTICAL
4	6	81.5	SPLIT VERTICAL

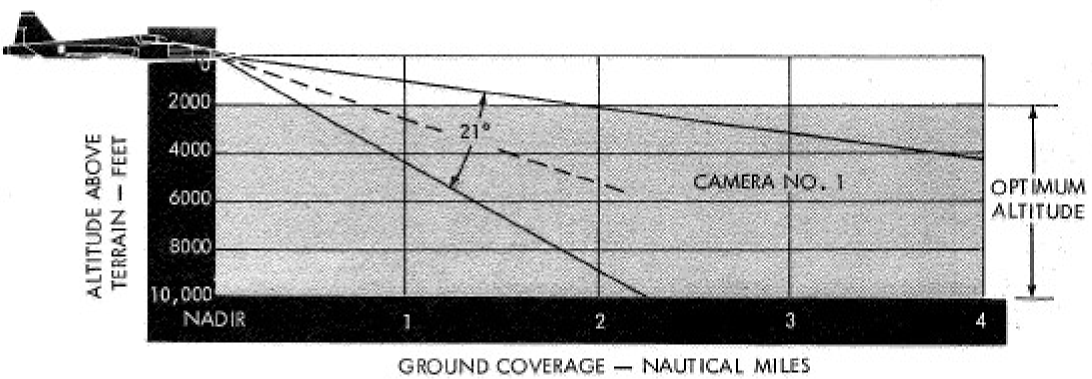
OPTIMUM ALTITUDE -2000 TO 10,000 FEET



Note

SATISFACTORY COVERAGE FROM 1000 TO 40,000 FEET.





F-5 1-149(1)B

Figure 1-76 (Sheet 4).

CAMERA AREA COVERAGE

ARRANGEMENT NO. 5

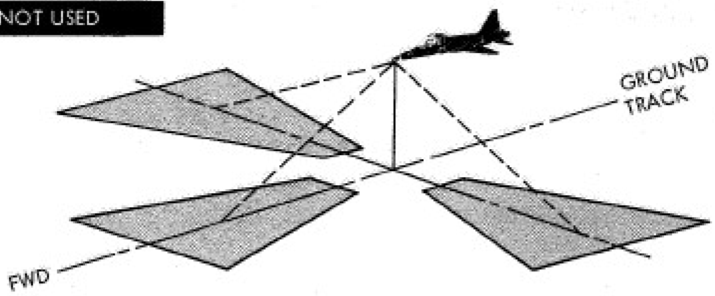
E-4

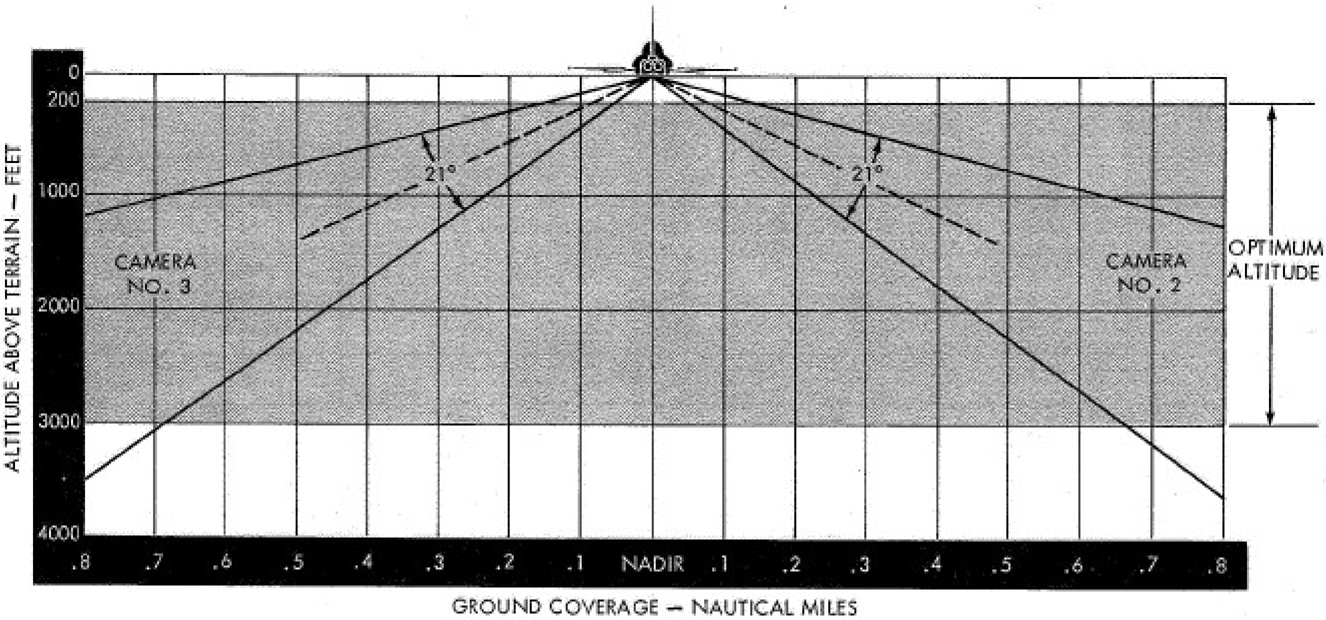
SPLIT OBLIQUE			
CAMERA NUMBER	FOCAL LENGTH — INCHES	DEPRESSION ANGLE — DEGREES	USAGE
1	3 OR 6	18	FWD OBLIQUE
2	6	25	R OBLIQUE
3	6	25	L OBLIQUE
4	—	—	NOT USED

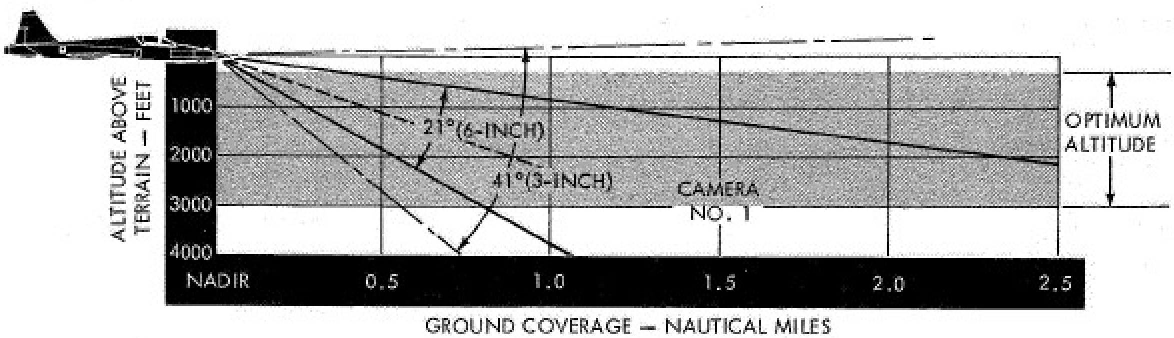
OPTIMUM ALTITUDE - 200 TO 3000 FEET

Note

SATISFACTORY COVERAGE FROM 200 TO 20,000 FEET.







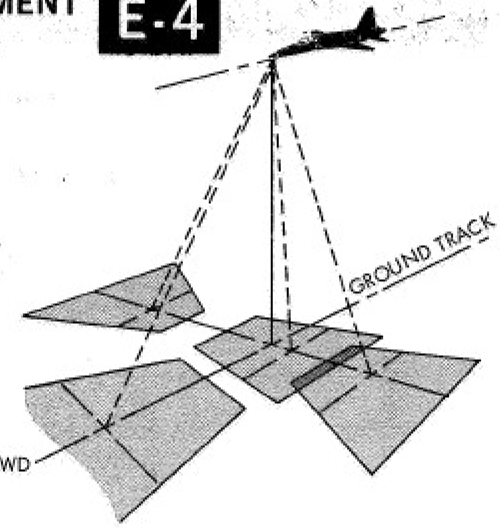
F-5 1-150(I)B

Figure 1-76 (Sheet 5).

CAMERA AREA COVERAGE

ARRANGEMENT NO. 6

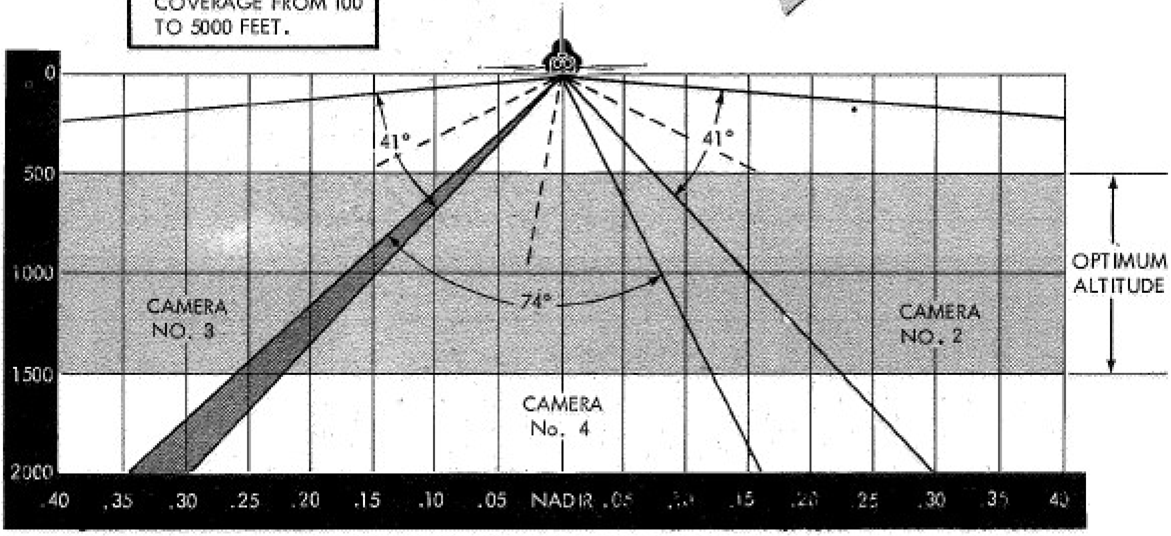
E-4

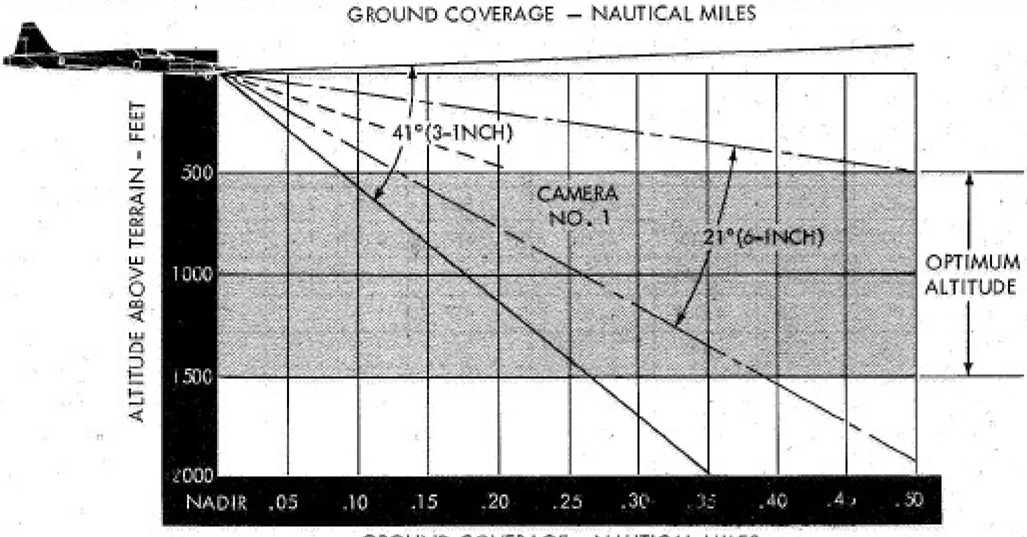


LEFT OBLIQUE			
CAMERA NUMBER	FOCAL LENGTH — INCHES	DEPRESSION ANGLE — DEGREES	USAGE
1	3 OR 6	18	FWD OBLIQUE
2	3	26	R OBLIQUE
3	3	26	L OBLIQUE
4	1.5	80	VERTICAL

OPTIMUM ALTITUDE - 500 TO 1500 FEET

> ***Note***
> SATISFACTORY COVERAGE FROM 100 TO 5000 FEET.





F-5 1-151(I)B

Figure 1-76 (Sheet 6).

VERTICAL STEREO—60% OVERLAP COVERAGE

E-4

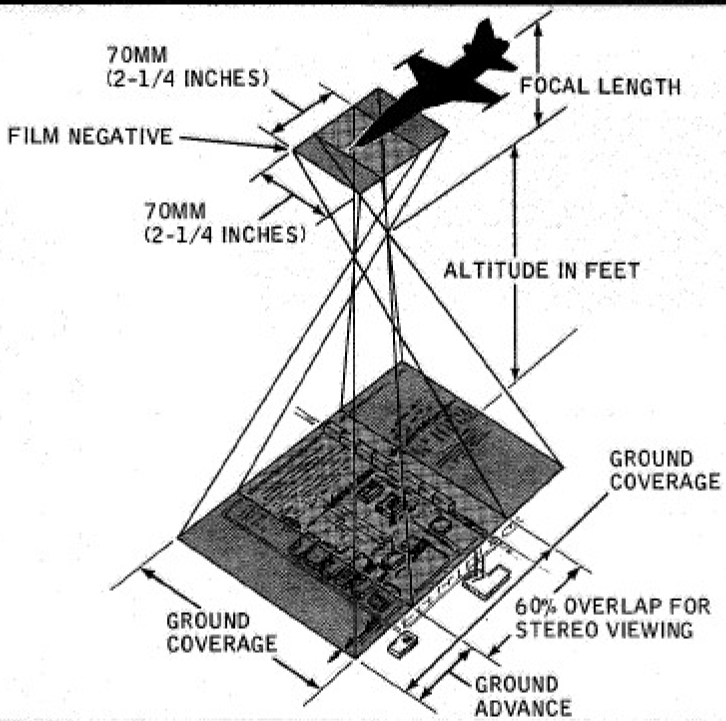


PHOTO SCALE ✱	ABSOLUTE ALTITUDE — FEET			GROUND COVERAGE SINGLE FRAME		INTVL-SEC SWITCH SETTING FOR GROUNDSPEED — KNOTS						
	LENS											
	1.5-IN	3.0-IN	6.0-IN	FEET LINEAR	METERS LINEAR	240	300	360	420	480	540	600
80,000	10,000	20,000	40,000	15,000	4,572	6.0	6.0	6.0	6.0	6.0	6.0	6.0
40,000	5,000	10,000	20,000	7,500	2,286	6.0	6.0	5.0	4.0	4.0	3.0	3.0
36,000	4,500	9,000	18,000	6,750	2,057	6.0	5.0	4.0	4.0	3.0	3.0	2.0
32,000	4,000	8,000	16,000	6,000	1,829	6.0	5.0	4.0	3.0	3.0	2.0	2.0
28,000	3,500	7,000	14,000	5,250	1,600	5.0	4.0	3.0	3.0	2.0	2.0	2.0
24,000	3,000	6,000	12,000	4,500	1,371	4.0	3.0	3.0	2.0	2.0	2.0	1.0
20,000	2,500	5,000	10,000	3,750	1,143	4.0	3.0	2.0	2.0	2.0	1.0	1.0
18,000	2,250	4,500	9,000	3,375	1,029	3.0	2.0	2.0	2.0	1.0	1.0	1.0
16,000	2,000	4,000	8,000	3,000	914	3.0	2.0	2.0	1.0	1.0	1.0	1.0
14,000	1,750	3,500	7,000	2,625	800	2.0	2.0	1.0	1.0	1.0	1.0	1.0
12,000	1,500	3,000	6,000	2,250	686	2.0	1.0	1.0	1.0	1.0	1.0	1/2
10,000	1,250	2,500	5,000	1,875	571	2.0	1.0	1.0	1.0	1.0	1/2	1/2
8,000	1,000	2,000	4,000	1,500	457	1.0	1.0	1.0	1/2	1/2	1/2	1/2
6,000	750	1,500	3,000	1,125	343	1.0	1/2	1/2	1/2	1/2	1/2	1/3
5,000	625	1,250	2,500	937	286	1.0	1/2	1/2	1/2	1/2	1/3	1/3
4,000	500	1,000	2,000	750	229	1/2	1/2	1/2	1/3	1/3	1/3	1/4
3,000	375	750	1,500	562	171	1/2	1/2	1/3	1/3	1/4	1/4	1/5
2,000	250	500	1,000	375	114	1/3	1/4	1/4	1/5	R	R	R
1,480	185	370	740	281	93	1/4	1/5	R	R	R	R	R
1,000	125	250	——	187	57	R	R	R	R	R	R	R

R = RUNAWAY (0.17-SECOND INTERVAL)
✱ RECIPROCAL

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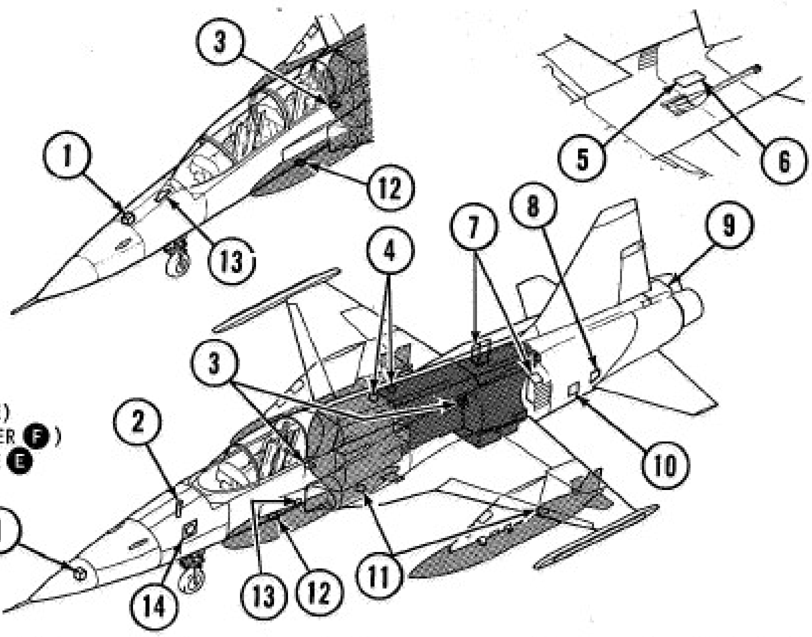
Figure 1-77.

SERVICING DIAGRAM

1. BATTERY
2. WINDSHIELD RAIN REMOVAL CONTAINER (E)
3. FUEL CELL DRAINS (UNDER RIGHT SIDE)
4. FUEL SYSTEM MANUAL FILLER CAPS
5. ENGINE STARTER AIR INLET
6. VEN ACTUATOR SERVICE ACCESS (IN STARTER AIR INLET DOOR)
7. HYDRAULIC RESERVOIR FILLER CAPS
8. OIL FILLER ACCESS DOOR (EACH SIDE)
9. DRAG CHUTE COMPARTMENT DOOR
10. EXTERNAL ELECTRICAL POWER RECEPTACLE
11. MANUAL FILLER CAP (EACH TANK)
12. SINGLE-POINT FUEL FILLER (UNDER LEFT SIDE)
13. OXYGEN FILLER VALVE (E) (LOX CONVERTER (F))
14. WINDSHIELD RAIN REMOVAL PRESSURE GAGE (E)



SPECIFICATIONS			REMARKS
ITEM	USAF	NATO	
FUEL	PRIMARY: JP-4 (MIL-T-5624) JET A-1 W/FSII OR JP-8 (MIL-T-83133) ALTERNATE: JET A-1 W/FSII OR JP-8 (MIL-T-83133) JP-4 (MIL-T-5624) EMERGENCY: JP-5 JET A-1(W/O ICING INHIBITOR)	 F-40 F-34 F-34 F-40 F-44 F-35	**WARNING** TO PRECLUDE EXCESSIVE ELECTROSTATIC DISCHARGE WHEN REFUELING WITH A FUEL GRADE OTHER THAN PREVIOUSLY CONTAINED IN TANKS, REDUCE SYSTEM PRESSURE TO 15-25 PSI. 1 SINGLE-POINT PRESSURE REFUELING: USE 45-55 PSI SYSTEM. 2 MANUAL REFUELING: FILL LEFT INTERNAL SYSTEM FIRST. IF EXTERNAL TANKS CARRIED, REFUEL AFTER INTERNAL SYSTEM IN SEQUENCE, CL AND WING TANKS.
ENGINE OIL	MIL-L-7808	0-148	CHECK OIL LEVEL IMMEDIATELY AFTER ENGINE SHUTDOWN (WITHIN 15 MINUTES).
HYDRAULIC FLUID	MIL-H-5606	H-515	1 PRESS FILLER CAP DOWN TO VENT RESERVOIR PRESSURE. 2 CAP UNLOCKED WHEN RED DOT SHOWS; LOCKED-GREEN DOT.
LIQUID OXYGEN	MIL-O-27210, TYPE II	NONE	1 TO BE FILLED ONLY BY QUALIFIED PERSONNEL. 2 USE MA-1 OR TYPE TMU27M TANK FOR SERVICE.
TIRE PRESSURE	SEE DECAL INBOARD OF EACH MAIN GEAR STRUT, UNDERSIDE OF WING SKIN SURFACE.	NONE	**WARNING** DO NOT USE HIGH-PRESSURE SERVICE SYSTEM.
EXTERNAL ELECTRICAL POWER	M32A-60A (USAF) OR EQUIVALENT NC-5 (USN) OR EQUIVALENT	NONE	OR A POWER UNIT WHICH MUST SUPPLY 3-PHASE, 115/200-VOLT, 400 Hz AC.
EXTERNAL AIR (JASU)	MA-1A (USAF) OR EQUIVALENT GTC-85 OR MA-1E (USN) WELLS AIR START SYSTEM M32A-60A	NONE	JASU RECOMMENDED MINIMUM OUTPUT: 350°F 42 PSIA 100 LB/MIN
WINDSHIELD RAIN REMOVAL (E)	RAIN REPELLENT FLUID CONTAINER, PART NO. 65-38196-2 (BOEING)	NONE	CHECK PRESSURE GAGE FOR GREEN ARC INDICATION (45-200 PSI).
VEN ACTUATOR POWER UNIT	MIL-L-7808	0-148	REQUIRES VEN ACTUATOR SERVICE CART, PN 21C3128G01.

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Figure 1-78.

GROUND SAFETY PINS

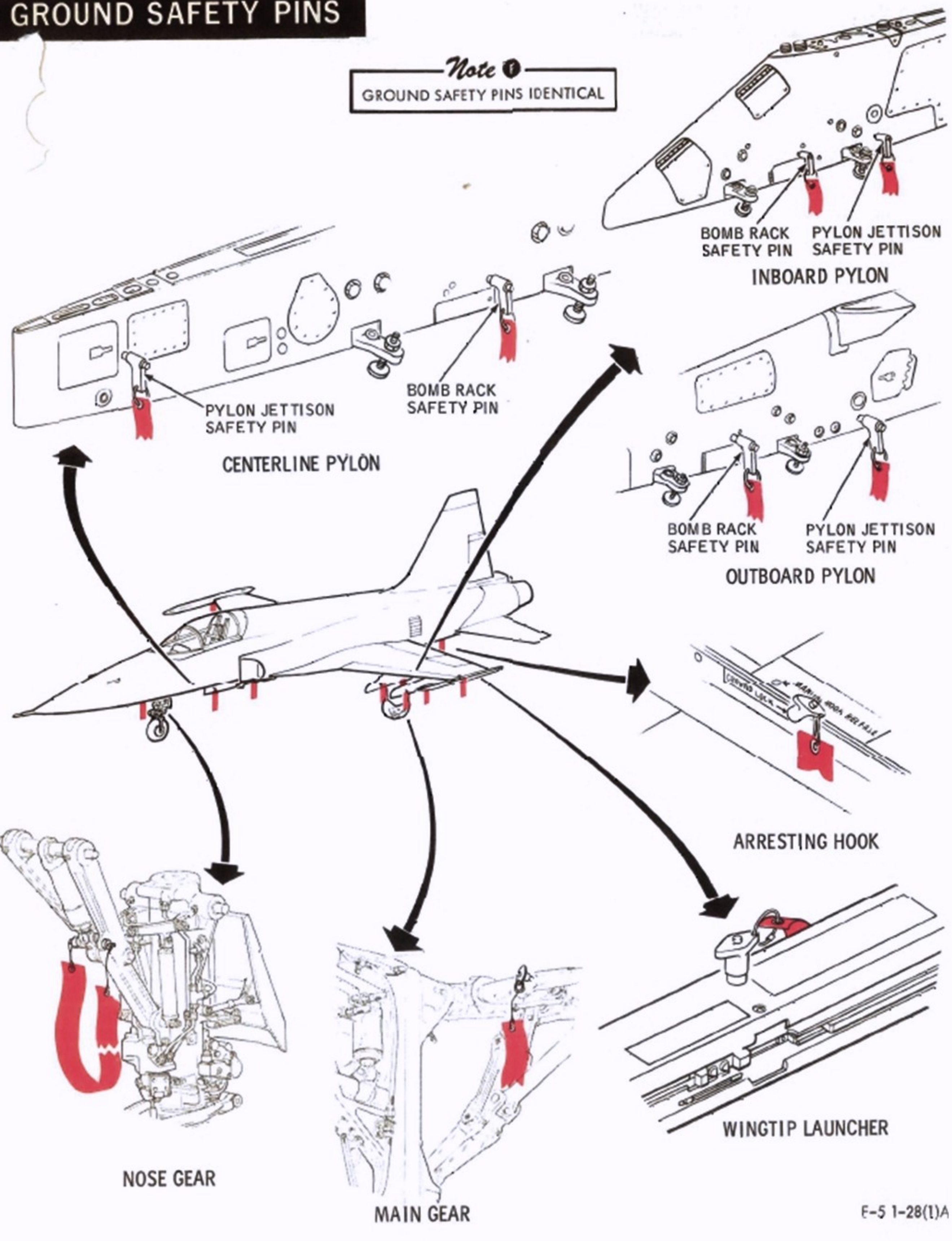

Figure 1-79.

SECTION II

NORMAL PROCEDURES

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TABLE OF CONTENTS

PREPARATION FOR FLIGHT

FLIGHT RESTRICTIONS

See section V for operating limitations.

FLIGHT PLANNING

See appendix I for takeoff, flight, and landing performance data.

TAKEOFF AND LANDING DATA CARD

See appendix I for information necessary to fill out the takeoff and landing data card in the checklist, T.O. 1F-5E-1CL-1.

WEIGHT AND BALANCE

Refer to T.O. 1-1B-40 for weight and balance. Ensure Form 365F filed for loaded configuration complies with authorized configurations in section V.

CHECKLIST

Your abbreviated checklist is T.O. 1F-5E-1CL-1.

ENTRANCE TO AIRCRAFT

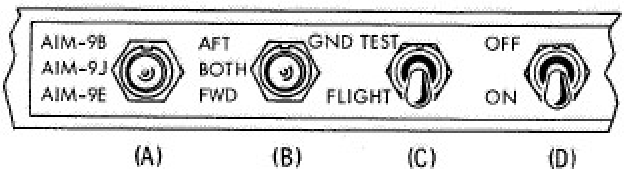
Unlock canopy using the canopy external handle and manually lift canopy to the open position. Entry is from the left side, using a ladder hooked over the canopy rail or the built-in retractable steps.

PREFLIGHT CHECK

BEFORE EXTERIOR INSPECTION

1. Form 781—Check.
   Check form for both aircraft status and proper servicing.
2. Seat and Canopy Safety Pins—Installed.
3. (F) Sequenced Ejection Dual-Gas Coupling Quick-Disconnect—Check.
   Visually verify proper connection of upper and lower halves of disconnect.
4. Seat Attachment Bolts—Check Alignment.
5. Switches Behind Headrest ((F) Rear Seat)—Check (4).
   A. AIM-9 Missile Select Switch—As Required.
   B. IFF Test Switch—BOTH.
   C. Aux Intake Doors Ground Test Switch—FLIGHT.
   D. AHRS Power Switch—ON.

SWITCHES BEHIND HEADREST



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6. Seat Ground Maintenance Safety Pins—Removed.
   If safety pins are installed, do not remove until status of system has been checked by maintenance personnel.
7. Landing Gear Lever—LG DOWN.
8. Gear Alternate Release Reset Control—RESET.
9. Armament and Jettison Switches—OFF and SAFE.
10. EXCEPT [E-1] [F-1] External Stores Jettison Handle—IN; Safety Pin—Installed.
11. Battery Switch—As Required.

NOTE

- Operation of static inverter and fuel and oxygen quantity indicators may be checked at this point, if desired.
- Failure of indicators to respond indicates static inverter failure.

12. External Power—As Required.
13. Publications—Check.

EXTERIOR INSPECTION

The aircraft should be checked for general condition, access doors and filler caps secured, and for hydraulic, oil and fuel leaks as well as the following:

1. Gear Safety Pins—Removed.
2. Pylon and Launcher Safety Pins—As Required.
3. Pylon Ordnance Selector(s)—As Required.
4. Pitot Cover—Removed.
5. AOA Vane Cover—Removed.
6. Aux Intake Doors—Closed.
7. Arresting Hook Safety Pin—As Required.
8. (F) External Tail Ballast—Total 4 Pieces (variable).
   See section V for additional store configuration ballast requirements for one and two crew.

WARNING

- <u>One Crew</u>: Variable tail ballast shall be removed for all flights with wing pylons, with or without stores.
- <u>Two Crew</u>: Variable tail ballast shall be removed for all flights with wing pylon stores.

9. Retractable Steps—Stowed.

INTERIOR INSPECTION
REAR COCKPIT (SOLO FLIGHTS) (F)

1. Ejection Sequence Selector—SOLO.

WARNING

Ensure that the ejection sequence selector is firmly seated and the arrow is aligned with the selected mode index mark.

2. Seat and Canopy Safety Pins—Installed.
3. Survival Kit—Removed or Secured.

WARNING

Automatic safety belt and shoulder harness do not provide adequate restraint for survival kit during zero or negative-g maneuvers.

PREFLIGHT CHECK (Continued)

4. Safety Belt and Shoulder Harness—Secure.
   Stow all loose equipment and secure automatic safety belt and shoulder harness.
5. Circuit Breakers—Check.
   All circuit breakers on left and right consoles in (closed).
6. Radar Override Switch—Off (guarded).
7. Comm/Nav Override Switch—Off (guarded).
8. Comm & Nav Equipment—As Required.
9. Oxygen Regulator—NORMAL/100%/OFF.
   Place oxygen emergency/test lever in NORMAL position, diluter lever in 100% position, and supply lever in OFF position.
10. Lighting Controls—OFF.
11. Instrument Hood—Remove or Secure.
    Check all bungee cords connected.
12. Canopy—Close and Lock.

COCKPIT

NOTE

Ⓕ On flights with both cockpits occupied, items marked with an asterisk (*) apply to crewmember in front cockpit.

1. Safety Belt, Shoulder Harness, Survival Kit, and Personal Equipment—Attach.

WARNING

- Ensure survival kit straps are routed under the safety belt to prevent interference and probable man-seat entanglement during the ejection sequence.
- The HBU-2B/A safety belt can be inadvertently opened by full aft and then full left movement of the control stick. This condition can be alleviated if the safety belt buckle is positioned so the shoulder harness loops are centered on the pilot, which will offset the safety belt buckle to the left of center.
- Pull Gold Key after insertion to ensure that it will be retained during ejection.
- (Improved seat/BA-25A only) Pull up hard on parachute harness right survival kit attach strap to assure full engagement of buckle and to prevent inadvertent release of survival kit.

2. Anti-g Suit Hose, Oxygen, and Communication Lead—Connect.

NOTE

- [E-1] [E-7] To prevent damage to hose between anti-g suit valve and seat, do not position hose behind canopy external crank mechanism.
- The oxygen hose from the mask to the quick-disconnect should be routed under the right shoulder harness strap before connection to the quick-disconnect. This helps keep the shoulder harness clear of the connector and prevents the harness from being snagged between the connector and its mounting plate during seat separation.

3. Zero Delay Lanyard (BA-22)—Attach.

Left Console

1. Circuit Breakers—Check.
*2. Rudder Trim Knob—Centered.
3. Radar Mode Selector—OFF.
4. [E-4] (Recon) Mode Selector and Camera Select Switches—OFF.
5. Flap Lever—THUMB SW.
6. Throttles—OFF.
7. Speed Brake Switch—Neutral
*8. Flap Thumb Switch—UP.
*9. Nose Strut Switch—RETRACT.
*10. EXCEPT Ⓔ [F-1] Antenna Switch—As Required.
*11. EXCEPT Ⓔ [F-1] Compass Switch—As Required.
*12. EXCEPT Ⓔ [F-1] SST-181X Switch—As Required.

Left Vertical

1. Fuel Shutoff Switches—LEFT and RIGHT (guards closed).
*2. Armament Light Control Knob—As Required.
*3. Landing & Taxi Light Switch—OFF.
*4. Landing Gear Alternate Release Handle—Fully Stowed.
*5. AIM-9 Missile Volume Control—Fully Counterclockwise.
*6. Armament and Jettison Switches—OFF and SAFE.
*7. EXCEPT [E-1] [F-1] External Stores Jettison Handle—In; Safety pin—Installed.

PREFLIGHT CHECK (Continued)

8. Ⓕ (Rear CKPT) Radar Override Switch—Off (guard closed).
9. Ⓕ (Rear CKPT) Comm-Nav Override Switch—Off (guard closed).

Instrument Panel

1. Landing Gear Lever—LG DOWN.
2. Drag Chute Handle—In.
3. Flight Instruments—Check and Set.
*4. Film Magazine/Dust Cover—Locked.
*5. Optical Sight Mode Selector—As Required.
6. Aux Intake Doors Indicator—Barber Pole.

Pedestal

1. UHF Radio—As Required.
2. TACAN—As Required.
3. Ⓕ (Rear CKPT) Ejection Sequence Selector—As Desired.

WARNING

Ensure that the ejection sequence selector is firmly seated and the arrow is aligned with the selected mode index mark.

4. [E-1] [F-1] Antenna Switch—As Required.
5. Ⓕ Intercom Knob—As Required.
*6. EXCEPT [F-1] Control Transfer Panel:
   a. NAV Switch—As Required.
   b. RADAR Switch—As Required.
   c. COMM Switch—As Required.
7. [E-1] [F-1] [T.O. 1F-5E-611] NAV MODE Switch—As Required.
8. Rudder Pedals—Adjust.
9. Brakes—Check.

NOTE

If brake pedals can be depressed to the mechanical stop, reject the aircraft.

* 10. Circuit Breakers—Check.

Right Vertical

*1. Cockpit Pressurization and Temperature Controls—As Required.
*2. Anti-Ice Switches—OFF.
*3. External Fuel Transfer Switches—OFF.
*4. Fuel Boost Pump Switches—LEFT and RIGHT.
*5. Crossfeed Switch—OFF.
*6. Auto Balance Switch—Centered.
7. Canopy Jettison T-handle—In; Safety Pin—Installed.
*8. Battery Switch—BATT.
9. Aux Intake Doors Indicator—CLOSE.
*10. Generator Switches—L GEN and R GEN.
11. EXCEPT Ⓕ [E-1] Compass Switch—As Required.
12. EXCEPT Ⓕ [E-1] SST-181X Switch—As Required.
13. EXCEPT Ⓕ [E-1] Antenna Switch—As Required.

Right Console

1. Oxygen System—Check.

SYSTEM

a. Supply Pressure Gage—Check (65-110 psi).
b. Quantity Indicator—Check.
c. Hoses and Connections—Check.

OPERATION

WARNING

It is possible for the oxygen supply lever to stop in an intermediate position between OFF and ON. Push the lever fully ON and check the flow indicator blinkers for proper functioning.

a. Supply Lever—ON.
b. Diluter Lever—NORMAL.
c. Emergency Lever—NORMAL.
d. Oxygen and Communications Leads—Connected.
e. Put on mask and check for normal blinker operation.

WARNING

If supply lever on earlier type regulators is in OFF position with the diluter lever in the normal oxygen position, the pilot will be breathing only cockpit air. Supply lever should be at ON to prevent hypoxia at altitudes requiring oxygen.

*2. IFF/SIF—STBY.
*3. Fuel and Oxygen Check Switch—GAGE TEST and QTY CHECK.

PREFLIGHT CHECK (Continued)

NOTE

Failure of indicators to respond indicates static inverter failure.

4. [E-1] [F-1] Compass Switch—As Required.
*5. [F-1] Control Transfer Panel:
   a. NAV Switch—As Required.
   b. RADAR Switch—As Required.
   c. COMM Switch—As Required.
6. [T.O. 1F-5E-611] VOR/ILS—As Required.
7. Interior Lights—As Required.
*8. Exterior Lights—As Required.
*9. Rotating Beacon—As Required.
10. Light Warning Test Switch—TEST.

NOTE

- Ⓕ When test switch in either cockpit is released, the fire warning lights in the other cockpit may come on momentarily.
- Ⓕ If warning test switches in both cockpits are actuated simultaneously, the fire warning lights, audible warning signal, and AOA lights will not operate in either cockpit.

11. Circuit Breakers—Check.

BEFORE STARTING ENGINES

1. External Power—Connect (if necessary).
2. Seat—Adjust (if ac power on).
3. Danger Areas Fore and Aft—Clear.

STARTING ENGINES

LEFT ENGINE

1. External Air—Apply.
2. At 10%RPM, Start Button—PUSH.
3. Throttle—Advance to IDLE.

CAUTION

- If lightoff does not occur within 5 seconds, retard throttle to OFF and continue motoring for at least 1 minute to purge engine before attempting another start.
- If egt reaches 845°C, retard throttle to OFF, continue motoring for 1 minute to cool engine.

NOTE

An EGT of less than 200°C cannot be read with the EHU-31A/A indicator; therefore, the ON position will be used as the minimum needle position.

4. Engine Instruments—Check Within Limits.
   a. Engine RPM (49% to 52%).
   b. EGT—Indication.
   c. Nozzle Position (70%—80%).
   d. Oil Pressure (5—20 psi).
5. Hydraulic Pressure—2800-3200 psi.
6. Generator Caution Light—Out.

NOTE

If light is on, check idle rpm. If idle rpm is low, advance throttle in an attempt to get generator on line before attempting generator reset.

7. Aux Intake Doors Indicator—Barber Pole.

RIGHT ENGINE

NOTE

Omit this procedure if crossbleed start is to be used.

1. Same as for Left Engine.
2. Aux Intake Doors Indicator—OPEN.
3. External Power and Air—Disconnect.

CROSSBLEED START

1. External Power and Air—Disconnect.
2. L Engine RPM—95%.

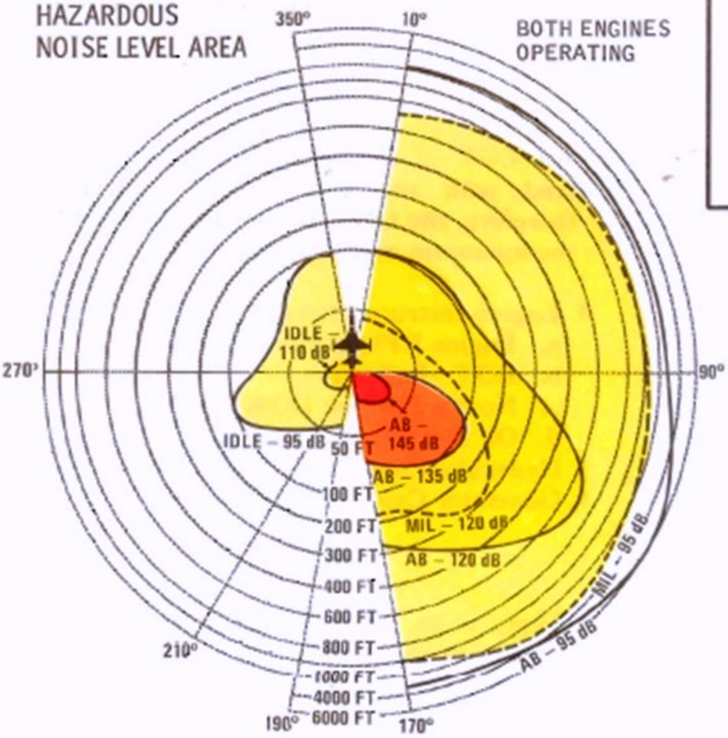
WARNING

Extreme care should be taken to avoid injury to ramp personnel caused by exhaust gases or blowing equipment since left engine is operating near military power. It is recommended that this procedure be used only in isolated areas.

3. R Engine Start Button—PUSH.
4. At 10% RPM, R Throttle—IDLE.
5. Engine Instruments—Check Within Limits.

DANGER AREAS

HAZARDOUS NOISE LEVEL AREA

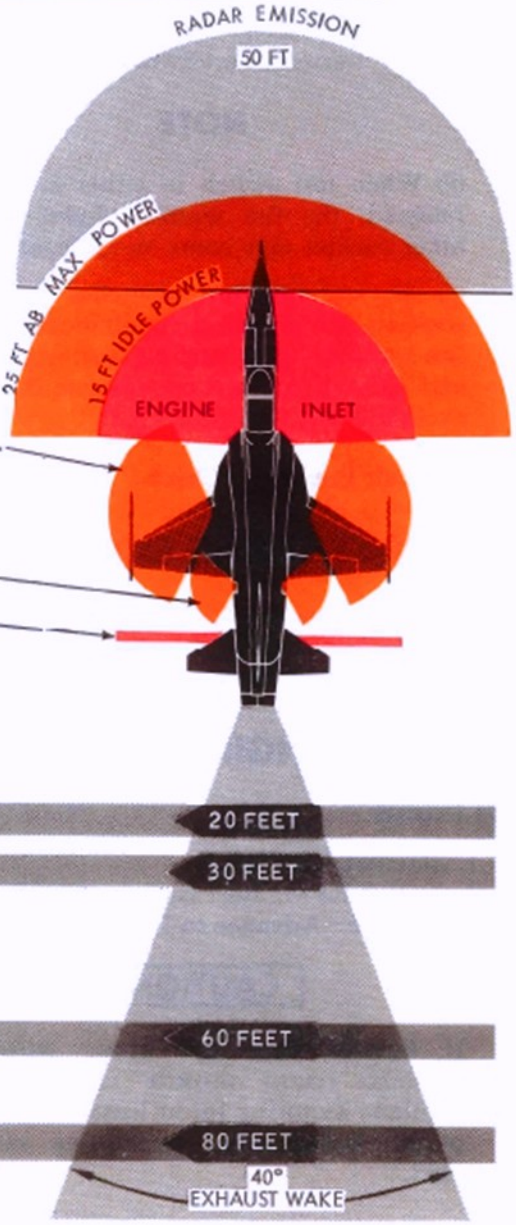


NOISE PROTECTION REQUIREMENTS

DECIBELS	REQUIRED EAR PROTECTION
0-95 dB	No Protection Required
95-120 dB	Ear Muffs or Ear Plugs Required
120-135 dB	Ear Muffs and Ear Plugs Required
135-145 dB	Ear Muffs and Ear Plugs Required Limited Time Exposure
Above 145 dB	Prohibited

Note

- NOISE LEVEL AREAS IDENTICAL ON EACH SIDE OF AIRCRAFT.
- CONTOURS MAY BE ALTERED BY SURROUNDING OBSTACLES.



TIRE AVOIDANCE AREA

AVOID AREA FOR 45 TO 60 MINUTES AFTER AIRCRAFT HAS STOPPED. IF NECESSARY TO APPROACH, DO SO FROM FRONT OR REAR ONLY.

AUXILIARY AIR INTAKE DOORS AREA

5-FOOT RADIUS

ENGINE AREA

ROTATING PLANE OF ENGINE TURBINES

ENGINE EXHAUST TEMPERATURES AND VELOCITY

MAX POWER			MIL POWER			IDLE POWER		
TEMP °F	TEMP °C	VELOCITY (MPH)	TEMP °F	TEMP °C	VELOCITY (MPH)	TEMP °F	TEMP °C	VELOCITY (MPH)
877	466	644	430	221	491	175	79	48
620	327	464	305	152	300	143	62	24
290	143	205	180	104	140	80	27	NEG
210	99	153	158	70	99	NEG		NEG

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Figure 2-1.

STARTING ENGINES (Continued)

6. L Throttle—Retard to IDLE after R Engine is at Idle RPM.
7. Generator Caution Lights—Out.
8. Aux Intake Doors Indicator—OPEN.
9. Hydraulic Pressure—2800-3200 psi.

BEFORE TAXI

1. Circuit Breakers—Check.
2. Radar Mode Selector—As Required.

WARNING

Ensure that radar is OFF or in STBY to avoid danger to personnel.

CAUTION

During ground operations, do not leave the radar in OPER, STBY, or TEST for more than 10 minutes to prevent radar malfunction from overheat. If necessary, turn radar OFF until immediately prior to takeoff.

3. Speed Brake—In.
   Check that speed brake retracts and horizontal tail moves trailing edge up to check speed brake and horizontal tail interconnect.

WARNING

To avoid injury, insure ground personnel clear before actuating controls.

4. Flap Thumb Switch—M.
   Flaps should extend to full. Verify that horizontal tail moves trailing edge down as flaps extend.

WARNING

Ⓕ If maneuver flaps are selected only in the rear cockpit, uncommanded flap retraction can occur.

*5. Damper Switches—YAW and PITCH.
*6. Pitch Damper Cutoff Switch—Check.
   a. Pitch Damper Cutoff Switch—Actuate.
   b. Pitch Damper Switch—Moves to OFF.
*7. Pitch Damper Switch—PITCH.
   If the horizontal tail moves when pitch damper is reengaged, a malfunctioning damper is indicated. Disengage pitch damper.
8. Flight Controls—Check.
9. Pitch Trim—Check and Set.

PITCH TRIM INCREMENTS FOR OPTIMUM TAKEOFF PERFORMANCE

	% MAC	*INCREMENTS*
Ⓔ	Aft of 18	6
	14 to 18	7
	10 to 14	8
	Fwd of 10	9
Ⓕ	Aft of 14	7
	10 to 14	8
	Fwd of 10	9

10. Aileron Trim—Check and Set As Required.
11. Altimeter (AAU-7A/A)—Check.
    After setting in field barometric pressure, check that indicated altitude is within ±75 feet of field elevation.
12. Altimeter (AAU-19/A)—RESET; (AAU-34/A)—ELECT.
    After setting the current field barometric pressure, place the function switch momentarily at STBY (PNEU AAU-34/A). Check that STBY (PNEU) flag is visible and that indicated altitude is within ±75 feet of field elevation. Place the function switch momentarily at RESET (ELECT AAU-34/A). Check that STBY (PNEU) flag is not visible and that indicated altitude is within ±60 feet of field elevation. The altitudes indicated in STBY and RESET (PNEU and ELECT) must be within 75 feet of each other.

CAUTION

Do not rotate the barometric set knob at a rapid rate or exert force to overcome momentary binding. If binding occurs, rotate the setting knob a full turn in the opposite direction and approach the desired setting carefully.

13. Standby Attitude Indicator—Check, Set and Uncage.
14. Canopy and Seat Safety Pins—Removed.
15. (Improved Survival Kit) AUTO/MANUAL Selector—As Required.

BEFORE TAXI (Continued)

16. Arresting Hook Safety Pin—Check Removed.
17. Wheel Brakes—Apply Heavy Pressure.
    Heavy pressure application to both brake pedals will set automatic brake adjusters and maintain minimum pedal travel for proper braking efficiency.
18. Nosewheel Steering—Engage (apply L and R rudder, and hold each for 5 seconds).

NOTE

This action applies maximum output torque to the nosewheel steering system. Dependent on factors such as ramp surface texture, tire friction, and gross weight, the nosewheel may not deflect fully. After test, ensure nosewheel steering system is operable during normal taxi.

19. Wheel Chocks—Removed.

TAXI

1. Wheel Brakes—Release.
2. Nosewheel Steering—Engage.
   Check operation at slow taxi speed. Ensure steering mode is terminated when nosewheel steering button is disengaged.

NOTE

If taxi route and conditions permit, momentarily releasing the nosewheel steering button may allow an operational check of the shimmy damper.

WARNING

If nosewheel steering does not function properly, takeoff should not be attempted, as shimmy damping may not be available. Undamped nosewheel shimmy can induce structural failure of the nose gear strut.

3. Flight Instruments—Check.
4. Navigation Equipment—Check.

BEFORE TAKEOFF

1. Nose Strut—Extend.

WARNING

- Failure of nose gear to extend (hike) may indicate a nose gear malfunction and takeoff should not be attempted.
- If takeoff is made with nose gear dehiked, expect up to 25% increase in airspeed for rotation, and up to 50% increase in takeoff roll.

2. Radar—As Required.
3. Pins, Belt, and Shoulder Harness—Check.
4. Gold Key and Lanyard (BA-22)—Check.
   Ensure gold key and lanyard are secured.

*5. EXCEPT [E-1] [F-1] Stores Jettison Safety Pin—Removed.
*6. Anti-Ice Switches—As Required.
*7. IFF/SIF—As Required.
8. Flight Controls—Check.
9. Canopy(ies)—Closed; Light—Out.
10. Caution and Warning Lights—Out.

NOTE

ENGINE ANTI-ICE ON light will be on if engine anti-ice switch is at ENGINE.

TAKEOFF

WARNING

Avoid wake turbulence. Allow a minimum of 2 minutes before takeoff behind a large multi-engine aircraft or helicopter. Extend the interval to 4 minutes behind an extremely large aircraft. With effective crosswinds of 5 knots or above, the interval may be reduced, but attempt to remain above and upwind of the preceding aircraft's flight path.

1. Wheel Brakes—Apply.
2. Throttles—MIL.
3. Engine Instruments—Check.
4. Wheel Brakes—Release.
5. Nosewheel Steering—As Required.

TAKEOFF (Continued)

CAUTION

Do not exceed 65 knots with nosewheel steering engaged.

WARNING

If nosewheel shimmy occurs, takeoff should be aborted if conditions permit.

6. Throttles—As Required.
   If selected, AB lightoff should occur within approximately 5 seconds.
7. Aft Stick—At 10 knots Below Takeoff Speed.
   If aft stick is applied earlier, rotation will not be immediate. Increased drag due to horizontal tail deflection will reduce acceleration and extend the takeoff roll. If aft stick is delayed or if aft movement exceeds 1 second, a longer takeoff roll will also result. The shortest takeoff results when rotation occurs just prior to reaching takeoff speed. See the appendix for takeoff speeds.

NOTE

- Ⓕ If aircraft has a CL store exceeding 1000 pounds (without wing stores), increase computed takeoff speed by 5 knots. Aft stick speed will be 10 knots less than this adjusted takeoff speed.
- Takeoff speed and full aft stick should be reached before aborting for nonrotation.
- During takeoff with a heavyweight CL store, a noticeable hesitation may occur between nose strut extension and takeoff.
- Takeoff performance charts (Appendix I) are based on full aft stick.

AFTER TAKEOFF

1. Gear—Up.

NOTE

A high-pitched whine may occur as the nose gear starts up.

2. Flap Thumb Switch—As Required.
3. Aux Intake Doors Indicator—Check CLOSE (approximately 255 ± 10 KIAS or 0.4 mach).

CLIMB

1. External Fuel/Autobalance—As Required.
2. Zero Delay Lanyard (BA-22)—Disconnect Above 2000 Feet AGL.

WARNING

Ejection above 400 KIAS with zero-delay lanyard connected can cause parachute canopy failure and/or serious injury.

3. Oxygen—NORMAL.
4. Cockpit Pressurization—Check.
5. Altimeter—As Required.

FUEL BALANCING

Figure 2-2 shows the typical effect on aircraft cg travel of internal fuel consumption with and without fuel balancing.

WARNING

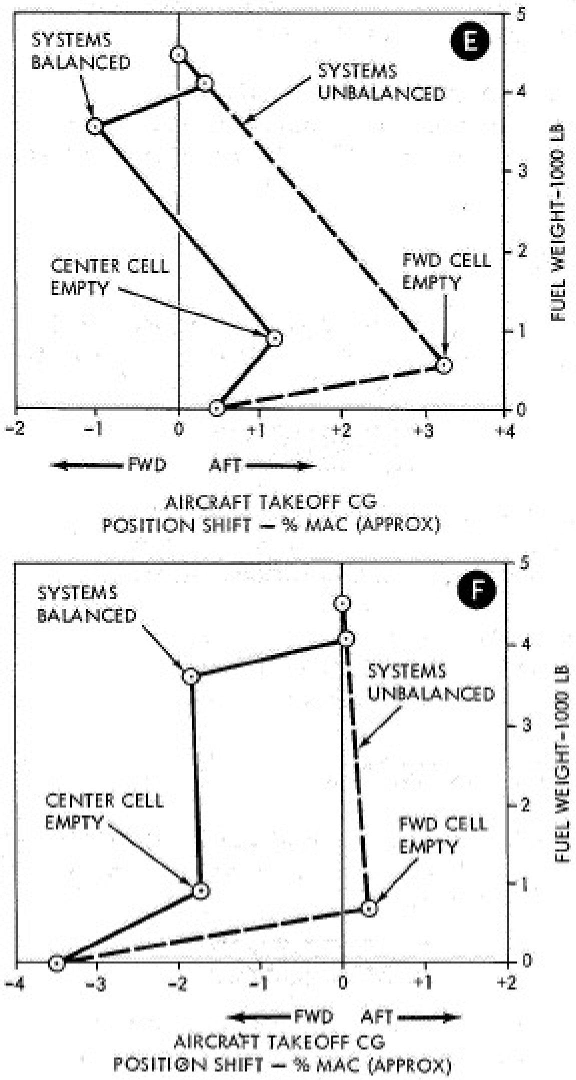
Ensure that proper switches for fuel balancing have been selected because an aggravated fuel imbalance may occur, resulting in out-of-limit cg.

NOTE

Fuel balancing should be delayed until external fuel transfer is complete.

FUEL BALANCING (Continued)

SAMPLE CG TRAVEL DUE TO INTERNAL FUEL CONSUMPTION



Note

- THE AFT (RIGHT) SYSTEM CONTAINS APPROXIMATELY 550 LB (85 GAL) MORE FUEL THAN THE FORWARD (LEFT) SYSTEM. THE TWO SYSTEMS SHOULD BE BALANCED AS SOON AFTER TAKEOFF AS POSSIBLE TO PREVENT AFT CG SHIFT. THIS DIAGRAM ASSUMES THAT INITIAL BALANCING IS PERFORMED BETWEEN 4050-LB AND 3500-LB FUEL LEVELS AND THAT THE TWO SYSTEMS ARE KEPT IN BALANCE UNTIL BOTH SYSTEMS ARE EMPTY.
- THE FUEL QUANTITY INDICATOR SHOULD BE MONITORED TO MAINTAIN THE TWO SYSTEMS WITHIN 200 LB OF EACH OTHER TO ENSURE THAT THE CG REMAINS WITHIN LIMITS.

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Figure 2-2.

AUTOBALANCING

*1. Auto Balance Switch—LEFT LOW or RIGHT LOW (as applicable).

NOTE

Switch will automatically return to center position when systems are balanced.

MANUAL BALANCING

*1. Crossfeed Switch—CROSSFEED.
*2. Fuel Boost Pump Switch (on low fuel side)—OFF.
*3. Systems Balanced; Boost Pump Switch—LEFT or RIGHT.

NOTE

After extended climbs, turn the boost pump on for a minimum of 2 minutes prior to turning crossfeed switch OFF to avoid vapor lock and possible engine flameout.

*4. Crossfeed Switch—OFF.

CRUISE

Perform level-off and operational checks, and check altimeter.

CAUTION

(AAU-19/A, AAU-34/A) If the altitude indications of the primary and standby modes vary more than 200 feet below 10,000 feet or 600 feet above 10,000 feet, fly the standby mode only for the remainder of the flight.

NOTE

(AAU-19/A, AAU-34/A) If the altimeter reverts to standby operation in flight, try to return to the primary mode by placing the function switch momentarily to RESET (ELECT AAU-34/A). If the altimeter will not reset or reverts to standby mode after a few seconds, continue in the standby mode.

DESCENT

1. Armament Safety Check—Complete.
2. Canopy Defog, Engine Anti-Ice, and Pitot Heat Switches—As Required.
   Canopy and windshield defogging should be initiated before descent from altitude in sufficient time to allow heating of transparent surfaces. Failure to do so will allow fogging of these surfaces at lower altitudes. Engine anti-ice and pitot heat should be applied for descent into known or suspected icing conditions.
3. Oxygen—Check.
4. Altimeter—Check and Set.

WARNING

- (AAU-19/A, AAU-34/A) Recheck altimeter in primary and standby modes in level flight prior to commencing descent. In normal conditions prior to penetration (300 KIAS, 20,000 feet), the maximum allowable error is 300 feet. If differences are exceeded, use standby mode for descent.
- (AAU-19/A, AAU-34/A) If the altimeter internal vibrator is inoperative due to instrument failure or dc power failure, the 100-foot pointer may stick or hang up momentarily when passing thru 0 (12-o'clock position). If the vibrator has failed, the hangup may be cleared by tapping the altimeter case.

5. Ⓕ (Rear CKPT) Ejection Sequence Selector—As Desired.
6. Zero Delay Lanyard (BA-22)—Attach.

NOTE

Lanyard should be attached to parachute ripcord handle at start of initial penetration or before reaching 2000 feet AGL.

BEFORE LANDING

1. Altimeter—Check and Set.
*2. Crossfeed—Discontinue
3. Hydraulic Systems—Check Pressure.
4. Shoulder Harness—As Required.
*5. Flap Thumb Switch—M.

WARNING

Ⓕ If maneuver flaps are selected only in the rear cockpit, uncommanded flap retraction can occur.

6. Gear—Down.

CAUTION

Ⓕ Failure of the landing gear lever interconnect cable when the gear is lowered from the rear cockpit may result in uncommanded gear retraction on landing. This condition may be prevented by physically checking the front cockpit landing gear lever full down when the gear is lowered from the rear cockpit.

7. Aux Intake Door Indicator—Check OPEN.
8. AOA—On Speed.

LANDING

WARNING

Avoid wake turbulence. Allow a minimum of 2 minutes separation before landing behind a large multiengine aircraft or helicopter. The time should be extended to a minimum of 4 minutes behind extremely large aircraft. With an effective crosswind of more than 5 knots, the interval may be reduced, but attempt to remain above and upwind of the preceding aircraft's flight path. Wake turbulence is most dangerous during the approach and flare prior to touchdown with calm or light crosswinds.

NOTE

Do not stop on runway with drag chute deployed, as taxiing may be impossible.

NORMAL LANDING

See figure 2-3 for typical landing pattern procedures. Use AOA as the primary attitude/airspeed reference throughout the final approach. If AOA is inoperative, maintain 145 KIAS (Ⓕ 150) plus weight correction. Accomplish a normal flare to touchdown. After touchdown, lower the nosewheel to the runway (approximately 3 seconds), and apply heavy braking. If runway length and conditions permit, aerodynamic braking may be used to conserve brakes and tires.

LANDING AND GO-AROUND PATTERN (TYPICAL)

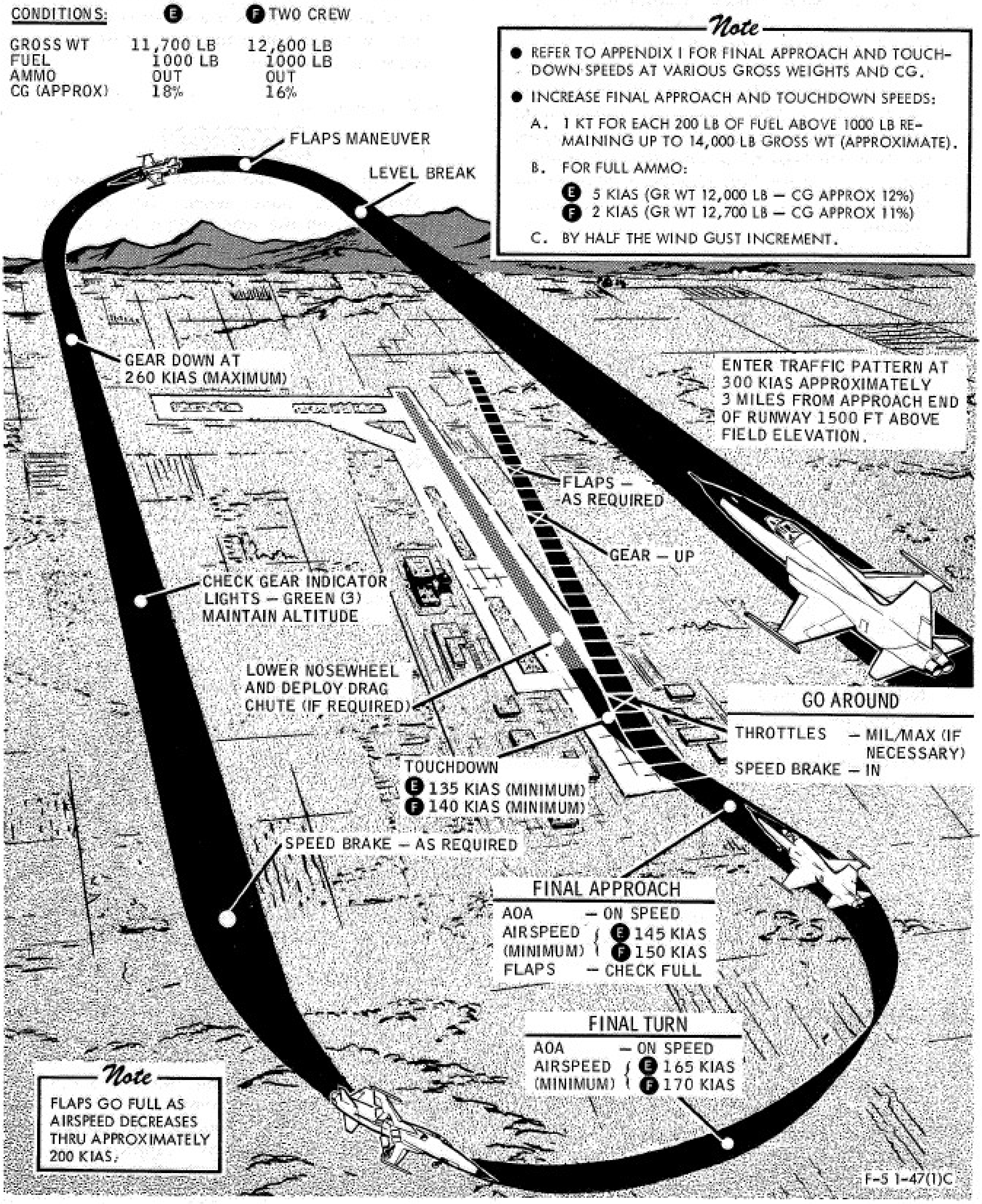


Figure 2-3.

LANDING (Continued)

Aerodynamic braking is achieved by easing the stick back gradually while in the flare to hold the nosewheel off the ground until desired pitch attitude is attained (approximately 12 degrees nose-up).

CAUTION

- Do not exceed 12 degrees pitch. The tailpipe will contact the runway at 15 degrees pitch.
- Ⓕ The nose wheel should be lowered to the runway prior to the loss of horizontal tail authority to minimize the potential of damaging the nose-gear structure and avionics.

If drag chute is to be used, lower the nosewheel to the runway before deploying the chute. Counteract aircraft yawing with rudder, nosewheel steering, and braking. See section V for landing gear sink rate limitations and the appendix for landing airspeeds and distances.

MINIMUM RUN LANDING

To accomplish a minimum run landing (shortest obtainable stopping distance), execute a normal approach and touchdown, then immediately lower the nosewheel, deploy the drag chute, and apply maximum wheel braking without skidding tires.

HEAVYWEIGHT LANDING

Fly a slightly wider than normal traffic pattern. Control the rate of sink to touchdown, using power as necessary. Full stall landings are not recommended at any gross weight.

CROSSWIND LANDING

Counteract drift by crabbing into the wind, maintaining flight path alignment with the runway. The crab should be held thru touchdown. The wings must be level at touchdown. After touchdown, maintain directional control of the aircraft with rudder. Use care when lowering the nose after touchdown, as premature lowering of the nose can result in a compression of the downwind strut, causing a turn toward the compressed strut. Use of aileron into the wind thruout the landing phase will minimize the strut compression tendency. After nosewheel touchdown, maintain directional control with nosewheel steering and braking. If drag chute is required, lower the nosewheel to the runway before deploying the chute and be prepared to counteract weathervaning tendency with rudder, nosewheel steering, and braking. If directional control cannot be maintained, jettison the drag chute immediately.

USE OF WHEEL BRAKES

Take advantage of all available runway to stop the aircraft. Brake application should be a steady increase of pressure. To prevent skidding, extreme care must be exercised when applying wheel brakes immediately after touchdown, at high landing speeds and/or heavy gross weights, or whenever there is considerable lift on the wings. Heavy brake pressure will lock the wheels more easily under these conditions. A locked wheel may result in a blown tire. See section VII for braking on a wet, slippery, or icy runway.

CAUTION

To prevent wheel lockup and skidding, do not pump brakes.

Maximum Braking

For maximum braking, lower the nosewheel to the runway and raise flaps before applying brakes. This will improve braking action by increasing the load on the tires and thus increase the frictional force between the tires and the runway.

Overheated Brakes

If brakes overheat during landing and taxi, stop the aircraft on the taxiway. Do not taxi into a crowded parking area. Overheated brakes and wheels must be cooled before the aircraft is towed or taxied. In extreme overheat cases, heat buildup can cause wheel assembly fuse plug blowout and tire failure. See section V for cooling times.

GO-AROUND

The decision to go around should be made as soon as possible and, when made, the following procedure applies:

a. Throttles—MIL/MAX (if necessary).
b. Speed Brake—IN.
c. Gear—Up, When Positive Rate of Climb is Established.
d. Flaps—As Required.

A short, closed-pattern go-around at approximately 12,000 pounds gross weight with launcher rails and five pylons, using two engines and military thrust for climb, requires approximately 200 pounds of fuel. Fuel consumption increases approximately 20 pounds for every 1000-pound increase in weight above 12,000 pounds.

LANDING (Continued)

TOUCH-AND-GO LANDING

Use normal landing procedures followed by a normal go-around.

WET OR SLIPPERY RUNWAY LANDING

See section VII, Adverse Weather Procedures.

AFTER LANDING—CLEAR OF RUNWAY

1. Drag Chute—Jettison (if deployed).

CAUTION

Do not allow the chute to collapse as the risers will be burned while resting on the hot tail section.

2. Cabin Pressure Altimeter—Check.
   If reading is below field elevation, place cockpit pressurization switch at RAM DUMP before opening canopy.
3. Flap Thumb Switch—UP.
4. Speed Brake—Out.
5. Radar Mode Selector—OFF.

WARNING

Ensure radar is OFF or in STBY to avoid radiation danger to personnel.

*6. Pitot Heat and Engine Anti-Ice Switches—OFF.
*7. IFF/SIF—OFF.
*8. Rotating Beacon—As Required.
9. Seat and Canopy Safety Pins—Installed (if desired).

ENGINE SHUTDOWN

1. Canopy(ies)—Open.

CAUTION

The canopy seal will remain inflated if engines are shut down with canopy locked. Attempts to open canopy with seals inflated may result in damage to canopy drive mechanism.

2. Wheel Brakes—Hold Until Chocks in Place.
3. All Unguarded Switches (except battery, generators, and fuel boost pumps)—OFF.
*4. Throttles—OFF.
   Allow engine rpm to stabilize for 5 to 10 seconds, throttles OFF.
*5. Battery Switch—OFF.

BEFORE LEAVING AIRCRAFT

1. Safety Pins—Installed.

CAUTION

EXCEPT [E-1] [F-1] Be careful not to actuate the emergency all jettison button when inserting the stores jettison safety pin.

2. Form 781—Complete.

INSTRUMENT FLIGHT PROCEDURES

INSTRUMENT TAKEOFF

For an instrument takeoff, perform all normal pretakeoff checks, and turn on pitot heat and engine anti-ice switches if necessary. Takeoff distances should allow for thrust loss when engine anti-ice system is in operation. Check the navigation indicator or HSI for proper heading and align the arrow on the pitch trim knob with the reference mark on the attitude indicator case. On a level surface with nosewheel hiked, this setting should indicate 0 degrees pitch attitude. This setting should give an approximate level flight indication for intermediate altitude level-offs during departures and at normal cruise conditions. Use normal instrument takeoff procedures. Whenever visibility permits, runway features and lights should be used to maintain heading. Increase the pitch attitude to attain an 8-degree nose high attitude indication and allow the aircraft to fly off the runway. When the vertical velocity indicator and altimeter indicate a definite climb, retract the landing gear.

INSTRUMENT CLIMB

Approaching 300 KIAS, retard throttles to MIL. Maintain a climb indication and at least a 1000 fpm climb until reaching recommended climb schedule. A slow airspeed and/or low rate of climb may be required to comply with departure procedures. For this type climb, reduce power below MIL as required. MAX thrust instrument climbs require

INSTRUMENT FLIGHT PROCEDURES (Continued)

extremely high pitch angles and are not normally used for instrument departures. If conditions require a MAX thrust climb, maintain climb until approaching recommended climb airspeed/mach; then adjust pitch to maintain climb schedule.

INSTRUMENT APPROACHES

See figures 2-4 and 2-5 for holding pattern, penetration descent, TACAN and radar approach, and missed approach procedures data. [T.O. 1F-5E-611] See figure 2-6 for VOR penetration, approach, and missed approach, and figure 2-7 for ILS approach and missed approach procedures data.

NIGHT FLYING

To prevent spatial disorientation, the rotary beacon light should be turned off in the vicinity of clouds or before entering a cloud formation. Frequent reference should be made to flight instruments during the landing approach.

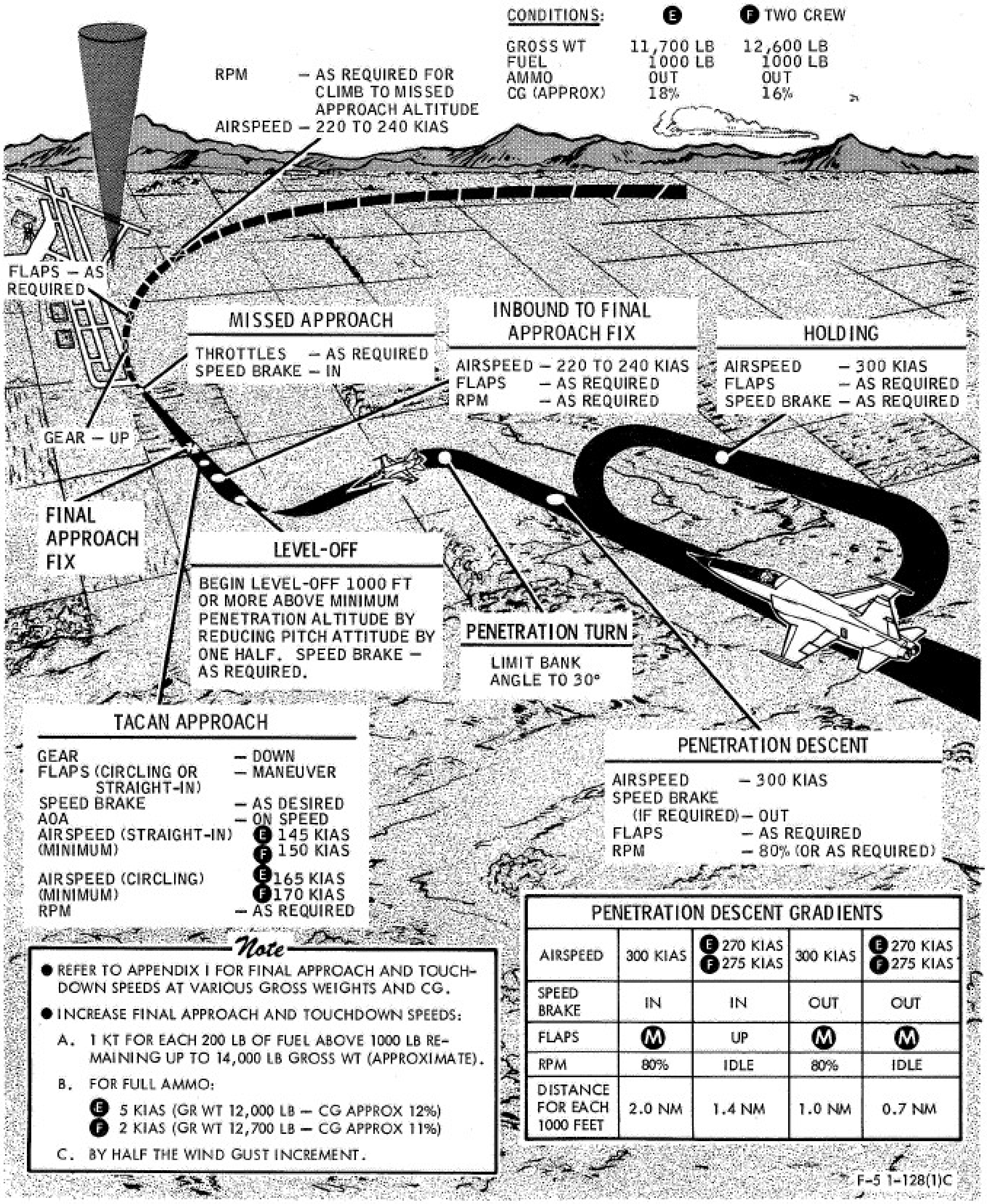
WARNING

[Before T.O. 1F-5-736] Pilots should avoid night weather formation flying due to the excessively bright auxiliary position lights (wing lights) and intake-mounted lights which can be mistaken for nonexistent tip launcher lights. If flight cannot be avoided, caution should be exercised during joinups and close formation to avoid pilot disorientation.

NOTE

During night and low visibility takeoffs with stores, the armament control panel should be illuminated to assist in locating the jettison controls for emergency jettison, if required.

TACAN PENETRATION AND APPROACH (TYPICAL)



PENETRATION DESCENT GRADIENTS

AIRSPEED	300 KIAS	(E) 270 KIAS (F) 275 KIAS	300 KIAS	(E) 270 KIAS (F) 275 KIAS
SPEED BRAKE	IN	IN	OUT	OUT
FLAPS	(M)	UP	(M)	(M)
RPM	80%	IDLE	80%	IDLE
DISTANCE FOR EACH 1000 FEET	2.0 NM	1.4 NM	1.0 NM	0.7 NM

Note

- REFER TO APPENDIX I FOR FINAL APPROACH AND TOUCHDOWN SPEEDS AT VARIOUS GROSS WEIGHTS AND CG.
- INCREASE FINAL APPROACH AND TOUCHDOWN SPEEDS:
  - A. 1 KT FOR EACH 200 LB OF FUEL ABOVE 1000 LB REMAINING UP TO 14,000 LB GROSS WT (APPROXIMATE).
  - B. FOR FULL AMMO:
    - (E) 5 KIAS (GR WT 12,000 LB – CG APPROX 12%)
    - (F) 2 KIAS (GR WT 12,700 LB – CG APPROX 11%)
  - C. BY HALF THE WIND GUST INCREMENT.

Figure 2-4.

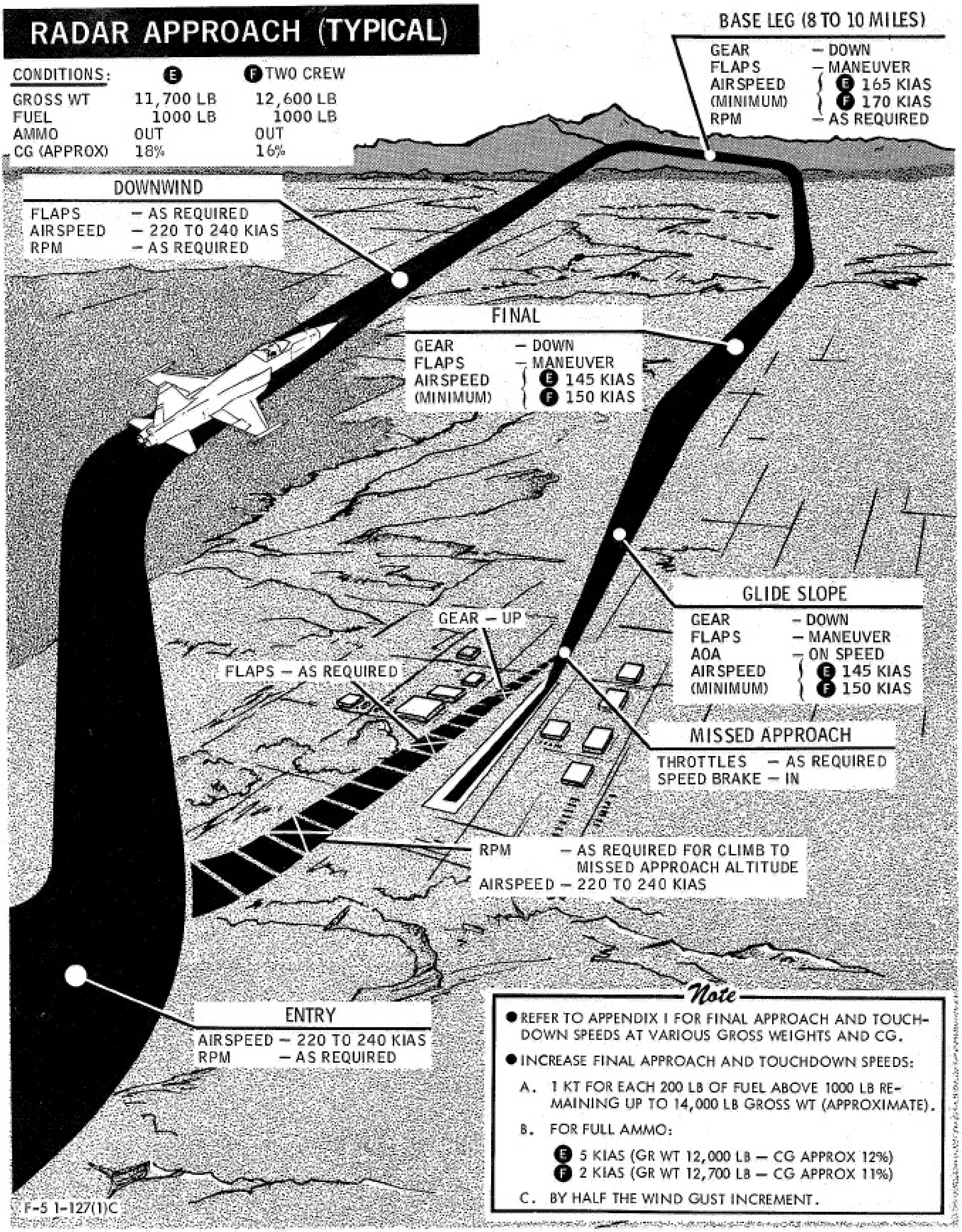
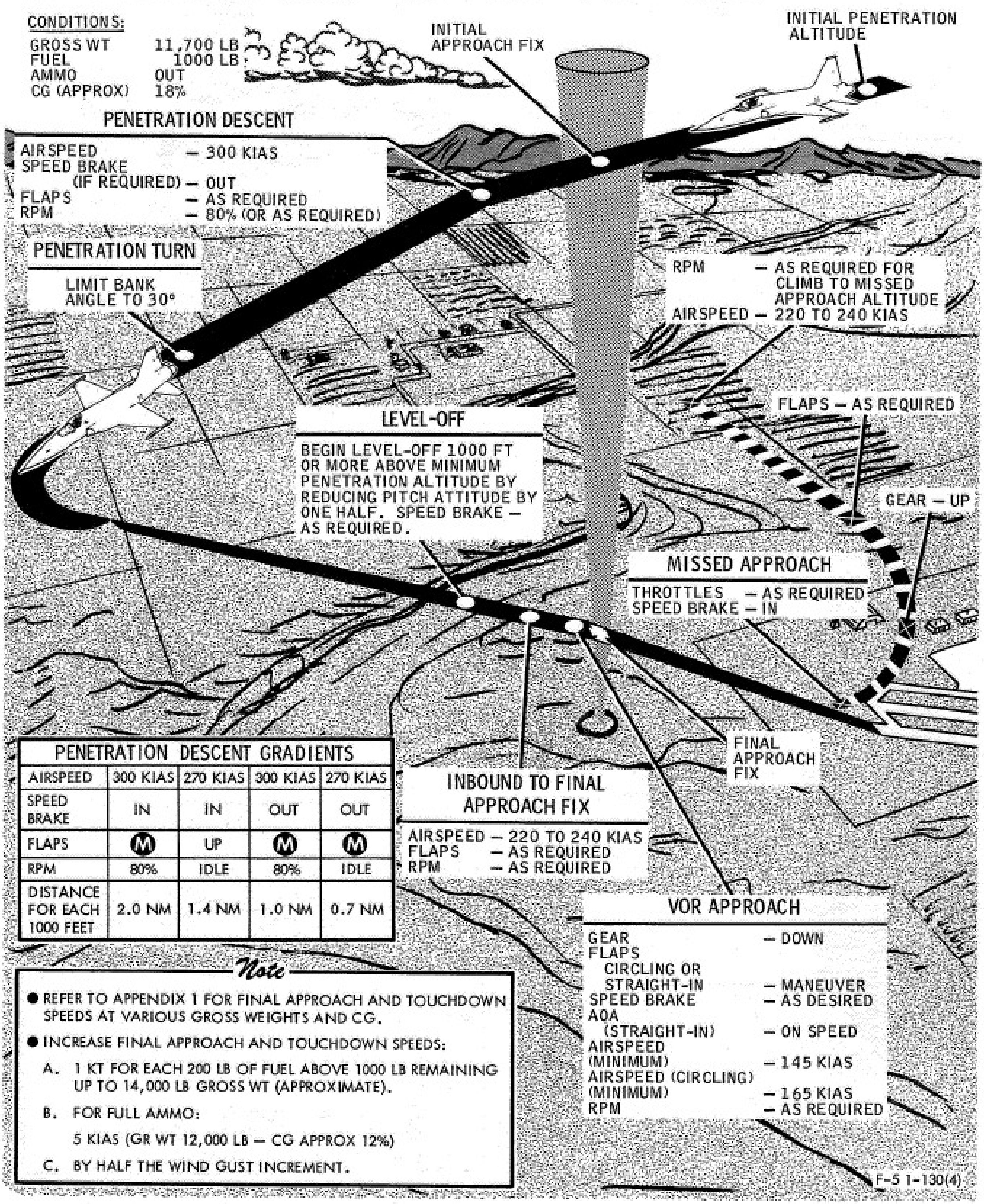

RADAR APPROACH (TYPICAL)
CONDITIONS: E F TWO CREW
GROSS WT 11,700 LB 12,600 LB
FUEL 1000 LB 1000 LB
AMMO OUT OUT
CG (APPROX) 18% 16%
BASE LEG (8 TO 10 MILES)
GEAR – DOWN
FLAPS – MANEUVER
AIRSPEED (MINIMUM) E 165 KIAS F 170 KIAS
RPM – AS REQUIRED
DOWNWIND
FLAPS – AS REQUIRED
AIRSPEED – 220 TO 240 KIAS
RPM – AS REQUIRED
FINAL
GEAR – DOWN
FLAPS – MANEUVER
AIRSPEED (MINIMUM) E 145 KIAS F 150 KIAS
GLIDE SLOPE
GEAR – DOWN
FLAPS – MANEUVER
AOA – ON SPEED
AIRSPEED (MINIMUM) E 145 KIAS F 150 KIAS
GEAR – UP
FLAPS – AS REQUIRED
MISSED APPROACH
THROTTLES – AS REQUIRED
SPEED BRAKE – IN
RPM – AS REQUIRED FOR CLIMB TO MISSED APPROACH ALTITUDE
AIRSPEED – 220 TO 240 KIAS
ENTRY
AIRSPEED – 220 TO 240 KIAS
RPM – AS REQUIRED
Note
● REFER TO APPENDIX I FOR FINAL APPROACH AND TOUCHDOWN SPEEDS AT VARIOUS GROSS WEIGHTS AND CG.
● INCREASE FINAL APPROACH AND TOUCHDOWN SPEEDS:
A. 1 KT FOR EACH 200 LB OF FUEL ABOVE 1000 LB REMAINING UP TO 14,000 LB GROSS WT (APPROXIMATE).
B. FOR FULL AMMO:
E 5 KIAS (GR WT 12,000 LB – CG APPROX 12%)
F 2 KIAS (GR WT 12,700 LB – CG APPROX 11%)
C. BY HALF THE WIND GUST INCREMENT.
F-5 1-127(1)C

Figure 2-5.

VOR PENETRATION AND APPROACH (TYPICAL) [T.O. 1F-5E-611]



PENETRATION DESCENT GRADIENTS

AIRSPEED	300 KIAS	270 KIAS	300 KIAS	270 KIAS
SPEED BRAKE	IN	IN	OUT	OUT
FLAPS	M	UP	M	M
RPM	80%	IDLE	80%	IDLE
DISTANCE FOR EACH 1000 FEET	2.0 NM	1.4 NM	1.0 NM	0.7 NM

Note

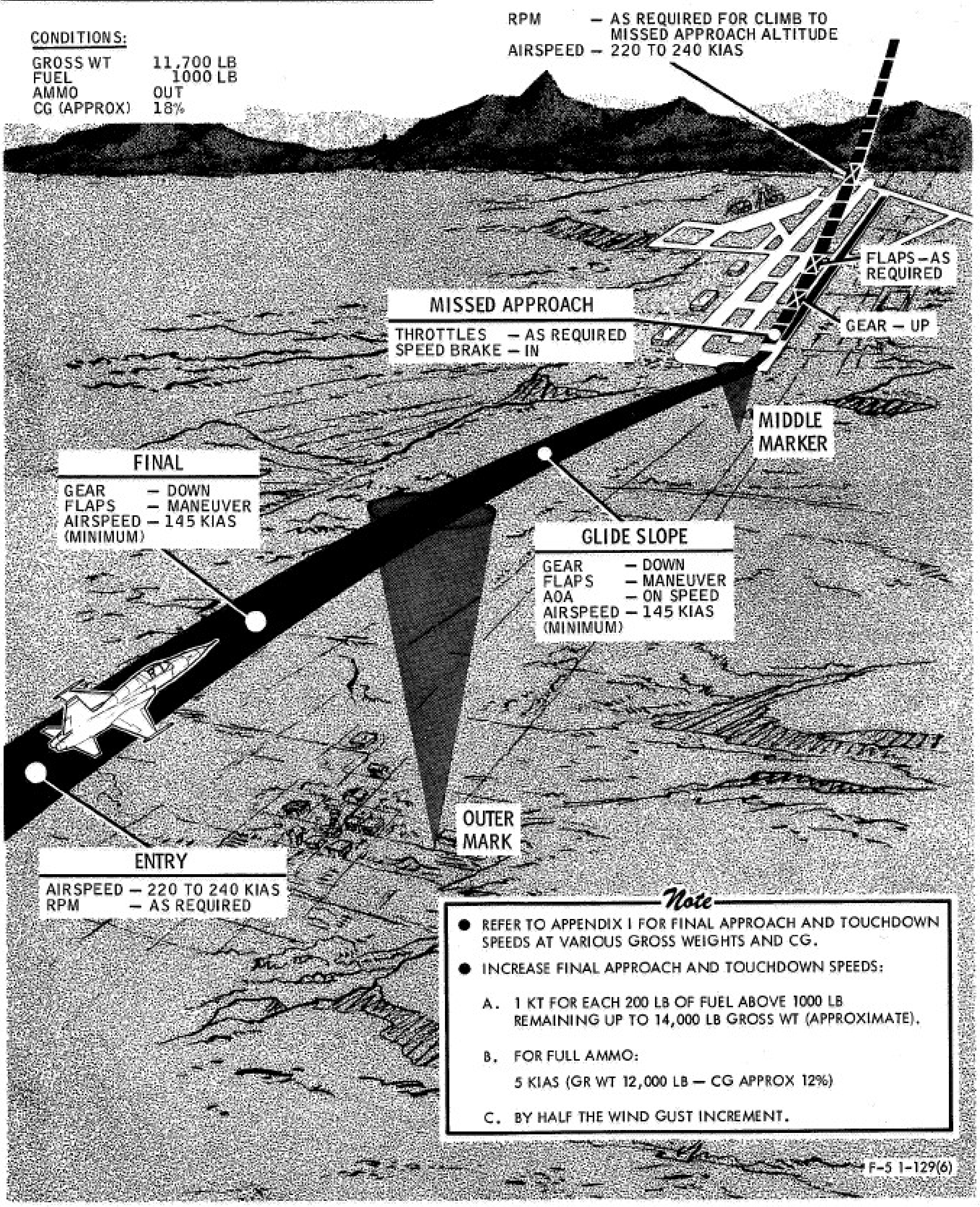
- REFER TO APPENDIX 1 FOR FINAL APPROACH AND TOUCHDOWN SPEEDS AT VARIOUS GROSS WEIGHTS AND CG.
- INCREASE FINAL APPROACH AND TOUCHDOWN SPEEDS:
  - A. 1 KT FOR EACH 200 LB OF FUEL ABOVE 1000 LB REMAINING UP TO 14,000 LB GROSS WT (APPROXIMATE).
  - B. FOR FULL AMMO:

    5 KIAS (GR WT 12,000 LB — CG APPROX 12%)
  - C. BY HALF THE WIND GUST INCREMENT.

Figure 2-6.

ILS APPROACH (TYPICAL)

[T.O. 1F-5E-611]



Note

- REFER TO APPENDIX I FOR FINAL APPROACH AND TOUCHDOWN SPEEDS AT VARIOUS GROSS WEIGHTS AND CG.
- INCREASE FINAL APPROACH AND TOUCHDOWN SPEEDS:

  A. 1 KT FOR EACH 200 LB OF FUEL ABOVE 1000 LB REMAINING UP TO 14,000 LB GROSS WT (APPROXIMATE).

  B. FOR FULL AMMO:

  5 KIAS (GR WT 12,000 LB – CG APPROX 12%)

  C. BY HALF THE WIND GUST INCREMENT.

Figure 2-7.

RECON CAMERA OPERATION E-4

RECON CAMERA(S) BIT TEST

1. Mode Selector—TEST.
2. INTVL-SEC Switch—TEST.
3. Camera Selector Switches (4)—ON.
4. BIT INITIATE Button—Press (momentary).
5. FRAMES REMAINING Counters (4)—Count Down 3 to 5 Digits.
6. GO Light (after 4 seconds)—ON.

NOTE

Ignore GO/NO-GO lights during 4-second test interval. If NO-GO light comes on after 4 seconds, repeat BIT test for each individual camera to isolate the defective camera.

CAMERA OPERATION

To Operate Cameras

1. Mode Selector—RMT.

NOTE

The camera remote operate button on the stick grip and the camera operate lights permit headup control and monitoring of the camera system. The CAMR OVERRIDE switch may be used for selective operation of an individual camera or all cameras.

2. INTVL-SEC Switch—As Required.
3. Camera Selector Switch(es)—ON (as required).
4. Camera Remote Button—Press and Hold.
   Selected cameras may also be operated by turning Mode Selector to OPR.
5. Camera Operate Lights—Monitor.
   Verify that selected cameras are operating and that interval indications are in accordance with setting.

NOTE

Between flight lines, check FRAMES REMAINING counters to verify film use and film remaining.

To Turn Off Cameras

1. Mode Selector—RMT or OFF.
2. Camera Selector Switch(es)—OFF.

To Operate Camera(s) With Camera Override Switch

1. Camera Override Switch—Desired Position.
   FWD —Camera No. 1
   R —Camera No. 2
   L —Camera No. 3
   VERT —Camera No. 4 (or 3 and 4)
   CENTER-PUSH Operates All Cameras.

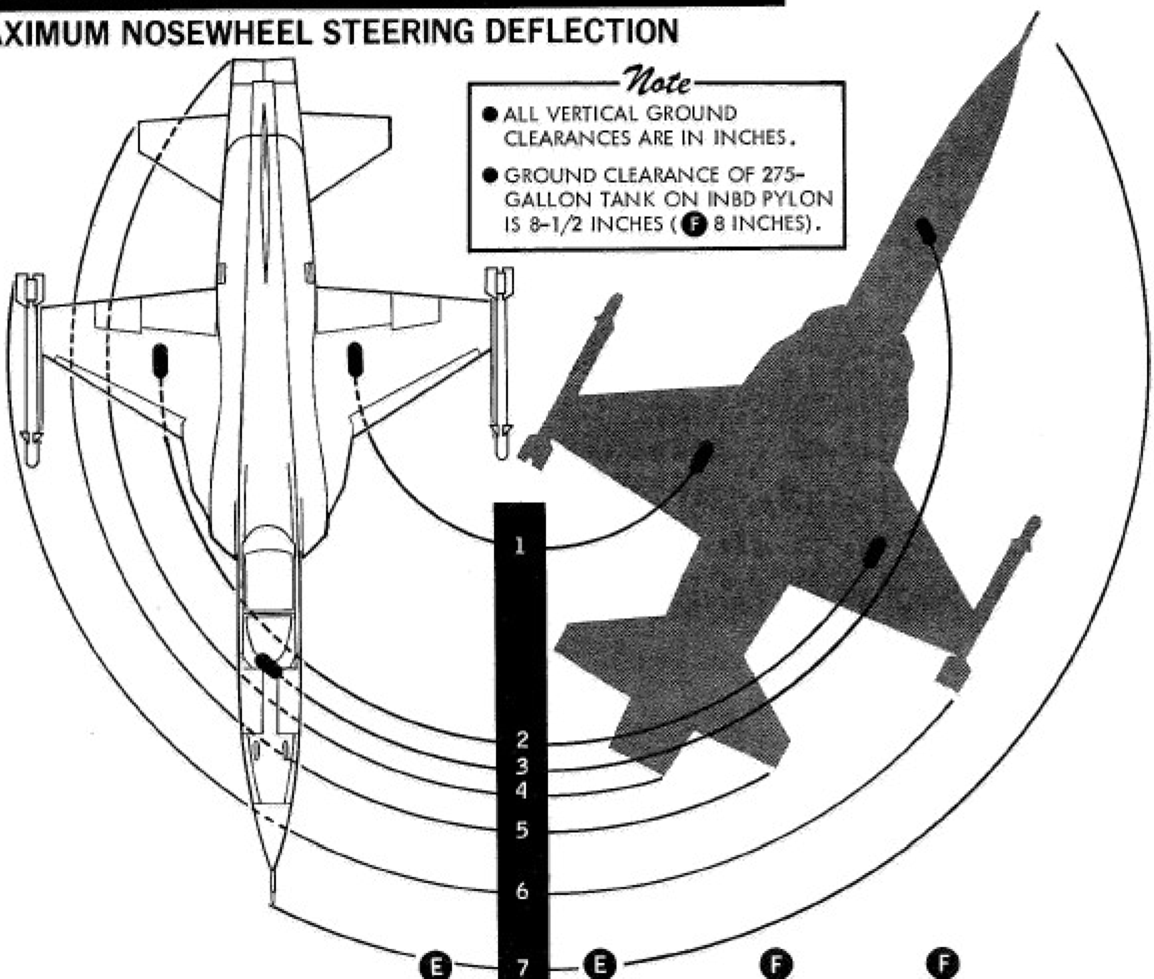
Camera (or cameras) selected will operate at runaway (RWY) interval or as rapidly as the shutter and film movement mechanism will cycle as long as switch is held in selected position.

To Turn Camera(s) Off After Use of Camera Override Switch

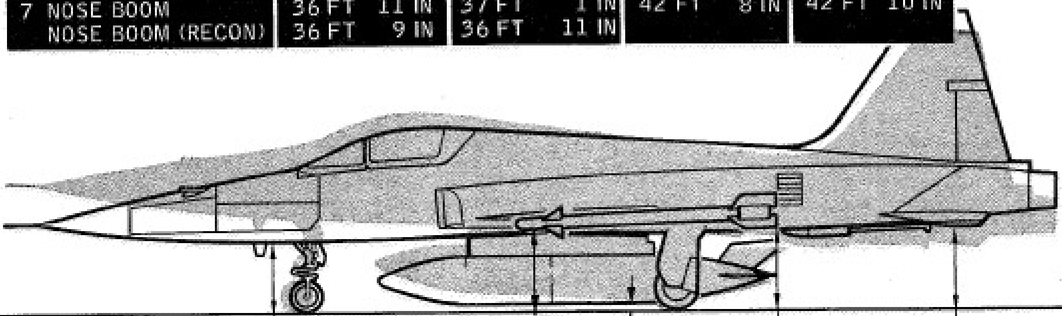
1. Camera Override Switch—CENTER and Release.

TURNING RADIUS/GROUND CLEARANCE

MAXIMUM NOSEWHEEL STEERING DEFLECTION



NOSE STRUT:	E DEHIKED	E HIKED	F DEHIKED	F HIKED
1 LEFT MAIN GEAR	13 FT 8 IN	13 FT 11 IN	18 FT 7 IN	18 FT 9 IN
2 RIGHT MAIN GEAR	26 FT 5 IN	26 FT 7 IN	31 FT 9 IN	31 FT 11 IN
3 TAILPIPE	26 FT 10 IN	27 FT 0 IN	31 FT 11 IN	32 FT 1 IN
4 NOSE GEAR	27 FT 10 IN	28 FT 0 IN	32 FT 10 IN	33 FT 0 IN
5 HORIZONTAL TAIL	30 FT 7 IN	30 FT 10 IN	34 FT 3 IN	34 FT 5 IN
6 MISSILE FIN	34 FT 6 IN	34 FT 8 IN	39 FT 5 IN	39 FT 7 IN
7 NOSE BOOM	36 FT 11 IN	37 FT 1 IN	42 FT 8 IN	42 FT 10 IN
NOSE BOOM (RECON)	36 FT 9 IN	36 FT 11 IN		



NOSE STRUT						
E	DEHIKED	38-1/3	46	7-3/4	41	44
	HIKED	47-3/4	49-1/2	8-3/4	38	37
F	DEHIKED	36-1/3	46-3/4	7-1/2	43-1/4	42-1/4
	HIKED	50-3/4	49-3/4	8-1/4	40-1/4	33-1/2

F-51-72(1)B

Figure 2-8.

EMERGENCY PROCEDURES

SECTION III

F-5 1-78(1)

TABLE OF CONTENTS

Page

GENERAL EMERGENCIES

GROUND OPERATIONS

TAKEOFF

INFLIGHT

TABLE OF CONTENTS Page

INFLIGHT (Continued)

NOTE

- Critical items (BOLDFACE PRINT) are those steps of an emergency procedure which must be performed immediately without reference to written checklists. All crewmembers are required to be able to demonstrate correct accomplishment of BOLDFACE procedures without reference to checklist.

- To assist the pilot when an emergency occurs, three basic rules are established which apply to most emergencies occurring while airborne and which should be remembered by each aircrew member.

1. Maintain Aircraft Control.
2. Analyze the Situation and Take Proper Action.
3. Land as Soon as Possible/Practical.

- Your emergency procedures checklist is contained in T.O. 1F-5E-1CL-1.

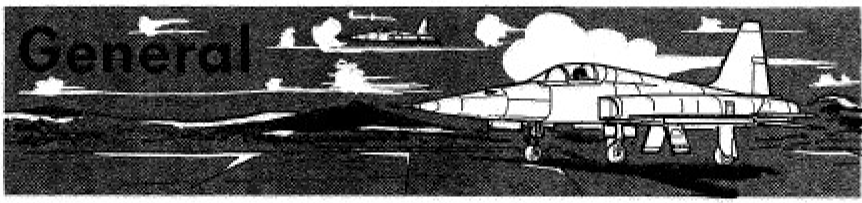
DEFINITIONS

Land As Soon As Possible. An emergency will be declared. A landing should be accomplished at the nearest suitable airfield considering the severity of the emergency, weather conditions, field facilities, ambient lighting, aircraft gross weight, and command guidance.

Land As Soon As Practical. Emergency conditions are less urgent, and although the mission is to be terminated, the degree of the emergency is such that an immediate landing at the nearest adequate airfield may not be necessary.

INCLUDES PROCEDURES THAT COULD BE USED IN TWO OR MORE PHASES OF OPERATION

F-5 1-95(1)



PHASES
GROUND
TAKEOFF
IN-FLIGHT
LANDING

CADC/PITOT STATIC MALFUNCTION

Illumination of the AIR DATA COMPUTER caution light on the caution light panel indicates a malfunction or failure of the CADC, although some internal failures can occur that do not result in caution light illumination. Additionally, a blocked or leaking pitot-static system may cause erroneous inputs to the CADC. If CADC failure or false input is detected or suspected, proceed as follows:

1. Pitch Damper Switch—OFF (if necessary).
   Pitch may become excessively sensitive at high airspeed with pitch damper on.
2. AAU-19/A, AAU-34/A Altimeter—Standby Mode.
3. Flap Lever—FULL (for approach and landing).
   Positioning flap lever at FULL will override possible erroneous maneuver flap setting.

CAUTION

Use of the maneuver flap position with unreliable CADC output may result in unexpected changes in flap position and possible flap overspeed.

4. Engine Aux Door Circuit Breakers—Pull (if desired).
   Pull right and left ac engine aux door circuit breakers (Ⓕ rear cockpit) to preclude the possiblity of door cycling and unexpected loss of thrust.

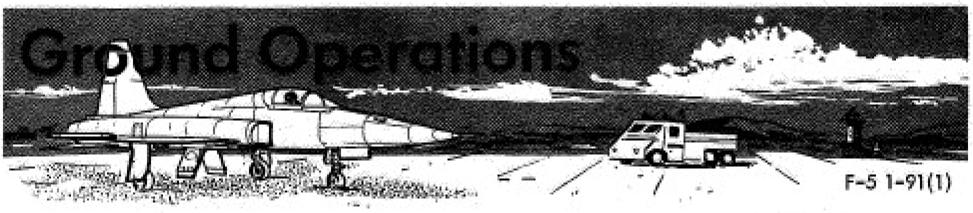
NOTE

If pitot-static malfunction is detected or suspected, AOA indications should be cross-checked frequently during approach and landing.

Inoperative/Unreliable Equipment

a. AAU-19/A, AAU-34/A Altimeter (primary mode).
b. IFF/SIF AIMS Altitude Reporting.
c. Lead Computing Optical Sight System.
d. Stability Augmenter System.
e. Maneuvering Flaps and Flap Audible Warning.
f. Aux Intake Doors Control.
g. Landing Gear Warning.

THIS PHASE OF OPERATION IS FROM STARTING ENGINES THRU TAXIING TO TAKEOFF POSITION AND AFTER LANDING ROLL FROM CLEAR OF RUNWAY TO ENGINE SHUTDOWN.



EMERGENCY ENTRANCE

Refer to figure 3-11 for emergency entrance. Unlock the canopy with the canopy external handle. If this fails, pull the canopy jettison external D-handle. If these two means of entrance fail, break into the rear portion of the canopy.

EMERGENCY EXIT ON THE GROUND

1. Canopy(ies)—Open (jettison, if necessary).

WARNING

The canopy seals will remain inflated if engines are shut down with canopy locked, and canopy may not open manually.

2. Throttles—OFF.
3. Battery Switch—OFF.
4. Seat Safety Pin—Install (if time permits).
5. Survival Kit emergency release handle—Pull.

WARNING

Pilot's weight must be on seat for emergency release.

6. Safety Belt and Shoulder Harness—Disconnect (when aircraft is stopped).
7. Personal Leads (communications, oxygen, anti-G suit)—Disconnect.
8. Parachute—Remove (if time permits). Removal of parachute will make it easier to get out of the cockpit. If parachute is kept on, do not allow parachute arming lanyard or the ripcord handle to catch and pull, deploying the parachute.
9. Canopy(ies)—Jettison (if not opened manually). If the canopy cannot be opened manually, pull the canopy jettison T-handle. If canopy does not jettison, break thru the canopy glass with the breaker tool (figure 3-11). To break the canopy, grasp the canopy breaker tool with both hands and use body weight behind an arm swinging vertical thrust. Aim the point of the tool to strike perpendicular to the canopy surface. Always use the point of the tool, as blade alignment determines the direction of the cracks. Reversing the tool to hammer with the butt produces ragged and unpredictable cracking.
10. Evacuate Aircraft.

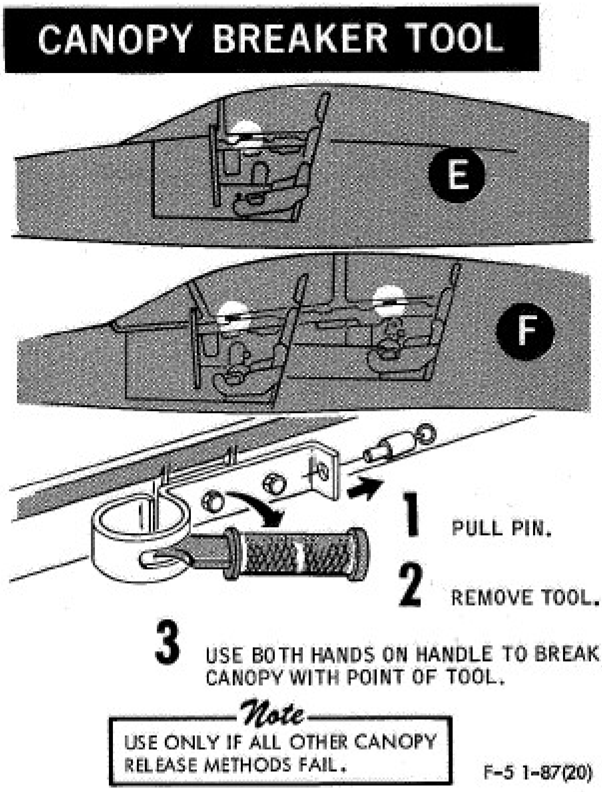


Figure 3-1.

ENGINE FIRE DURING START

If a fire warning light comes on, or if there are other indications of fire, proceed as follows:

1. Throttles—OFF.

If Engines Fail to Shut Down

2. Fuel Shutoff Switches—CLOSED.

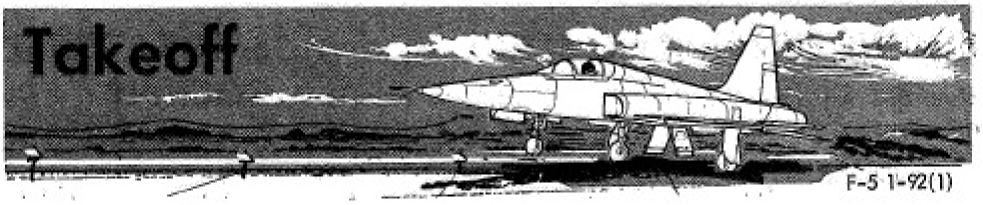
SMOKE, FUMES, OR ODOR IN COCKPIT

Do not take off if smoke, fumes, or unidentified odors are detected.

1. Oxygen—100%.
2. Check for Fire.

If required, see Emergency Ground Egress procedure, this section.

THIS PHASE OF OPERATION IS FROM THE TIME THE THROTTLE IS ADVANCED FOR TAKEOFF UNTIL THE AIRCRAFT IS CLEANED UP AND INITIAL CLIMB ESTABLISHED.



ABORT/ARRESTMENT

1. **THROTTLES—IDLE.**
2. **CHUTE—DEPLOY.**
3. **HOOK—DOWN.**

CAUTION

- Nosewheel should be on the ground before arrestment.
- Hook should be extended as soon as arrestment need is evident. Early extension is required to permit hook stabilization prior to arrestment.

WARNING

Jettisoning stores on runway may endanger aircraft and personnel due to possible impact detonation, fire, and collision with landing gear.

To minimize yaw induced by arrestment, steer straight for the middle of the runway. Arrestment should be perpendicular to the cable. Offcenter arrestment may result in rapid and unpredictable oscillations. Rudder should be used as the primary directional control until the rudder becomes ineffective. Stop braking before the nosewheel crosses the cable. External stores with less than 8-inch clearance may be damaged crossing over the cable but should not affect the engagement. Arrestment speeds are in Section V.

NOTE

- Only arrestment systems listed in section V are certified.
- Possibility of successful engagement of MA-1A barrier is doubtful when carrying external stores or with speed brake extended.

SINGLE-ENGINE TAKEOFF CHARACTERISTICS

If an engine fails and takeoff is continued use MAX thrust until safe ejection altitude is reached. The effect on directional control of loss of an engine is slight and opposite rudder will maintain heading. Aft stick should be applied 5 knots before single-engine takeoff speed. However, if available runway permits, increase airspeed as much as possible before attempting takeoff. Stores should be jettisoned unless it is evident that acceleration is more than adequate and the additional weight and drag penalty is acceptable.

Do not raise landing gear until at least 10 knots above single-engine takeoff speed but no later than 210 KIAS. Raising gear too soon may result in aircraft settling to runway.

NOTE

If the left engine is inoperative, normal windmilling rpm should be sufficient to provide hydraulic pressure for gear retraction; however, gear doors may not close completely. If the left engine is frozen and utility hydraulic pressure is zero, the landing gear lever should be left in the LG DOWN position to avoid additional drag caused by gear doors opening.

Single-engine takeoff speed provides a minimum of 300 feet per minute climb out of ground effect with full flaps and gear down. If close-in obstacle clearance is a consideration, use this speed for initial climb. If obstacle clearance is not a consideration, accelerate as much above the computed single-engine takeoff speed as runway permits. (See appendix for single-engine climb gradient charts.) Aircraft control is critical at this speed and any abrupt control inputs could increase drag and place the aircraft behind the power curve at an altitude where recovery is impossible. The

SINGLE-ENGINE TAKEOFF CHARACTERISTICS (Continued)

primary concern with either engine failure or fire warning emergencies is acceleration to an airspeed at which more than adequate aircraft control and thrust/drag ratio are available before initiating the climb. The flap thumb switch should be left at M (maneuver) during takeoff, acceleration, and climb. Recommended airspeeds for single-engine climb to a safe ejection altitude (2000 feet AGL) with the following conditions are:

RECOMMENDED SINGLE-ENGINE CLIMB SPEEDS

GEAR	FLAPS	KIAS
Down	Maneuver	210
Up	Maneuver	260
Up	Up	290

ENGINE FAILURE/FIRE WARNING DURING TAKEOFF

If Takeoff Is Refused

1. Abort.

See Abort/Arrestment procedures, this section.

If Takeoff Is Continued

1. THROTTLES—MAX.

WARNING

- Continuing a takeoff on single engine should be attempted only at MAX thrust. No attempt should be made to reduce power on the bad engine due to the possibility of confusion and the necessity of maintaining all available thrust to safe ejection altitude.
- If engine failure occurs after rotation, it may be necessary to lower the nose to the runway; or, if airborne, allow the aircraft to settle back on the runway until single-engine takeoff speed is attained. Increase airspeed as much above single-engine takeoff speed as available runway permits before attempting takeoff.

2. Stores—Jettison (If Necessary).

WARNING

Jettisoning stores on runway may endanger aircraft and personnel due to possible impact detonation, fire, and collision with landing gear.

3. At Safe Ejection Altitude—Perform In-Flight Engine Failure/Fire Warning Procedures.

TIRE FAILURE ON TAKEOFF

If Takeoff Is Refused

1. Abort.

See Abort/Arrestment procedures, this section.

If Takeoff Is Continued

1. GEAR—DO NOT RETRACT.
See Landing With Tire Failure, this section.

NOTE

If conditions permit, gear retraction may be considered after visual sighting confirms that damage caused by the tire failure does not preclude raising the gear.

NOSE GEAR

If nose gear tire fails during takeoff and the decision is to abort, make maximum use of nosewheel steering and wheel braking to maintain directional control. Use heavy braking and deploy drag chute to stop.

CAUTION

Nosewheel tire disintegration on takeoff can cause FOD ingestion in engine.

MAIN GEAR

If a main gear tire fails during takeoff and the decision is to abort, maintain directional control with nosewheel steering and braking. Use brakes and deploy drag chute to stop. The drag created by the failed tire can be equalized by braking the opposite wheel.

NOSEWHEEL SHIMMY

Nosewheel steering should normally be discontinued above 65 KIAS. Some failures of the nosewheel steering actuator or actuator output shaft can preclude nosewheel shimmy damping. If takeoff with a failed damper assembly is attempted, oscillations in nosewheel deflection will be induced. These will appear as a "snaking" motion and can result in catastrophic failure of the nose gear strut assembly at speeds as low as 30 knots. Do not attempt takeoff with a nosewheel steering system malfunction. If a shimmy or "snaking" is encountered on takeoff, an abort should be initiated immediately if conditions permit. The aircraft should be stopped as expeditiously as possible. Aft stick may reduce nosewheel shimmy.

WARNING

If takeoff must be continued, see to Tire Failure On Takeoff and/or Landing Gear Extension Failure emergency procedures, this section. Anticipate possible structural failure of the nose gear strut.

NOTE

Dehiking the nose gear strut will reduce the possibility of structural failure. The nose gear will automatically cycle to the dehiked position when the arresting hook is released.

LANDING GEAR RETRACTION FAILURE

If the warning light in the landing gear lever remains on after the lever has been moved to LG UP:

1. Airspeed—Maintain Below 260 KIAS.
2. Alternate Release Handle—Verify Proper Stowage.
3. Gear Lever—LG DOWN, then LG UP.
4. Throttles—MIL.
5. If Light Remains on With Throttles Cycled to MIL—Lower Gear.

If the light goes out, proceed with flight; however, note the discrepancy in Form 781.

EMERGENCY JETTISON

1. Emergency All Jettison Button — PUSH.

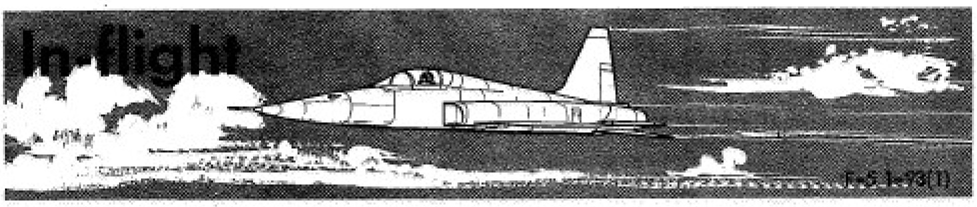
If Stores Fail To Jettison EXCEPT [E-1] [F-1]

1. External Stores Jettison T-Handle—PULL.

If Stores Fail To Jettison [E-1] [F-1]

1. Select Jettison Switch—ALL PYLONS. Pull switch out and down.
2. Select Jettison Pushbutton—Push.

THIS PHASE OF OPERATION IS FROM THE TERMINATION OF TAKEOFF TO THE INITIATION OF LANDING.



ENGINE FAILURE

1. Throttle (good engine)—As Required.
2. Stores—Jettison (if necessary).
3. Landing Gear—Up.
4. Speed Brake—In.
5. Flaps—As Required.
6. Throttle (failed engine)—OFF.
7. Fuel Balancing—As Required.

Inoperative Equipment With Left Engine Failed

a. Speed Brake.
b. Landing Gear Normal Extension.
c. Nosewheel Steering.
d. Stability Augmenter.
e. Gun Gas Deflector and Purge Doors.
f. Normal Braking.

SINGLE-ENGINE FLIGHT CHARACTERISTICS

Single-engine directional control can be maintained at all speeds. Little rudder movement is required because of the close proximity of thrust lines to the centerline of the aircraft. Under high drag and/or maximum gross weight conditions, the aircraft may not maintain altitude on one engine with gear and flaps extended.

WARNING

- Minimum safe single-engine flying speed with gear and flaps up and external stores jettisoned under standard ambient temperature conditions is 190 KIAS ((F) 200 KIAS). Add 1 KIAS for each 1°C above standard ambient temperature conditions. Single-engine maximum thrust will provide a minimum rate of climb of 300 fpm out of ground effect under these conditions.
- When performing practice maneuvers to simulate single-engine operation, retard desired engine throttle to IDLE. If single-engine landings, GCA's, or low approaches are being simulated, both engines should be used for go-arounds.

SINGLE/DUAL ENGINE FAILURE/ FLAMEOUT AT LOW ALTITUDE

1. **THROTTLES—MAX.**
2. Engine Instruments—Monitor.

If both engines fail at low altitude and with sufficient airspeed, zoom the aircraft to exchange airspeed for altitude and time. Try to airstart immediately upon flameout. Aircraft attitude should not exceed 20 degrees nose-up during zoom. Ejection should be done while aircraft is in a positive climb. If continued airstarts are to be attempted, lower the nose before airspeed drops below 250 KIAS.

WARNING

With dual engine flameout, battery switch must be at BATT to provide ignition.

NOTE

- Normally, engine should light off within 10 seconds and accelerate into afterburner. If lightoff does not occur within 10 seconds, throttle should be left in AB range for an additional 30 seconds to allow for delay in start within the complete ignition cycle (40 seconds).
- If flameout occurs while operating in AB, the throttle must be cycled to MIL and returned to AB to reactivate the ignition cycle; or the start button must be pushed and held to provide continuous ignition while in AB. After engine start, the throttle may be left in AB if desired.

AIRSTART

Airstarts can be expected over the range of operating conditions shown in figure 3-2. (See AIRSTART, section I.) The engine design requirements are based on engine windmill speed and pressure altitude and are independent of

AIRSTART (Continued)

AIRSTART ENVELOPE

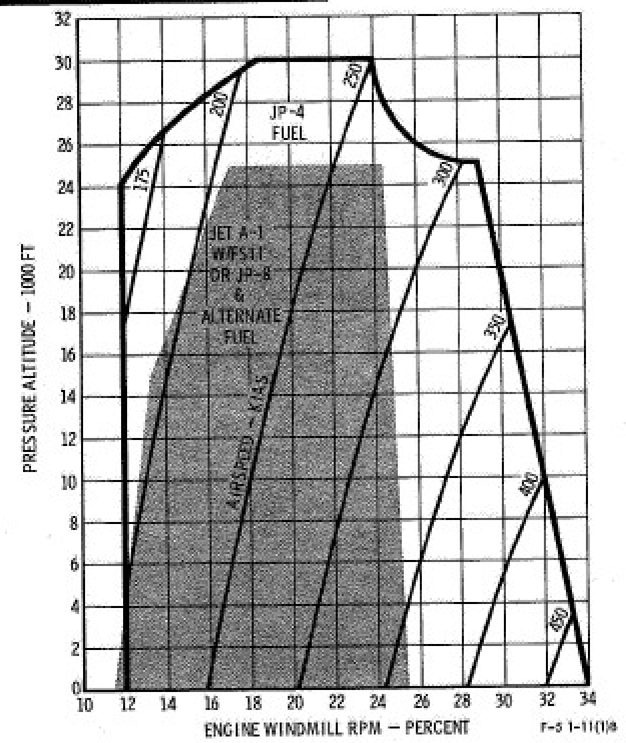


Figure 3-2.

ambient temperature. Lines of constant indicated airspeed have been superimposed on the basic engine requirements. These are the indicated airspeeds required to achieve corresponding windmill speeds. Airstart attempts at engine windmill speeds below the lower limit will normally result in a hung start. The engine will light off, as evidenced by egt rise, but will fail to accelerate up to idle. If airspeed is increased and/or altitude decreased with an engine in a hung start, it may accelerate up to operating speed. Airstart attempts at engine windmill speeds higher than the upper limit will normally fail due to the inability of the engine to light off (no egt rise). Combustion may be established by decreasing airspeed and/or decreasing altitude. Since the ignition circuitry is energized for about 40 seconds after pushing the start button, it may be necessary to press the start button again. Use the following procedure.

1. Throttle—OFF.
2. Altitude—Below 30,000 feet (25,000 feet w/ JET A-1 with FSII or JP-8).
3. Airspeed—250 KIAS (approximate) (240 KIAS w/JET A-1 with FSII or JP-8).
4. Fuel Boost Pump Switches—LEFT/RIGHT.
5. Battery Switch—BATT (check).
6. Start Button—PUSH.
7. Throttle—Advance to IDLE.
8. Engine Instruments—Maintain Within Operating Limits.

NOTE

- Leave throttle at IDLE for 40 seconds before aborting start.
- If airstart is aborted, check engine ignition circuit breakers before attempting next start.
- If both engines flame out, and conditions permit, left engine start should be attempted first because left engine instruments will operate normally as soon as start button is actuated.
- In the case of hung starts, an EGT of less than 200°C cannot be read with the EHU 31A/A indicator.
- If attempted airstart is unsuccessful, increase airspeed approximately 5 to 10 KIAS when using JP-4 or decrease approximately 5 to 10 KIAS when using JET-A1 or JP-8 before attempting another airstart.

ALTERNATE AIRSTART

1. Throttle(s)—OFF (or below MIL).
2. Altitude—Below 30,000 feet (25,000 feet w/ JET A-1 with FSII or JP-8).
3. Airspeed—250 KIAS (approximate) (240 KIAS w/JET A-1 with FSII or JP-8).
4. Battery Switch—BATT (check).
5. Throttle(s)—MAX.

Engine should light within 10 seconds and accelerate to MAX.

MAXIMUM GLIDE
(BOTH ENGINES WINDMILLING)

DATA BASIS
- DATE: 1 AUGUST 1976
- **FLIGHT TEST**
- GROSS WEIGHT — 13,300 LB
- FLAPS — UP

Note

APPROXIMATE GLIDE DISTANCE FOR EACH 1000 FT AGL:

WITH OR WITHOUT PYLONS — 1.1 NM
WINGTIP MISSILE EFFECT — NEGLIGIBLE

WITH JET A-1 OR JP-8 FUEL
- BEST AIRSTART GLIDE SPEED — 240 KIAS
- AIRSPEED DIFFERENCE EFFECT ON DISTANCE — NEGLIGIBLE

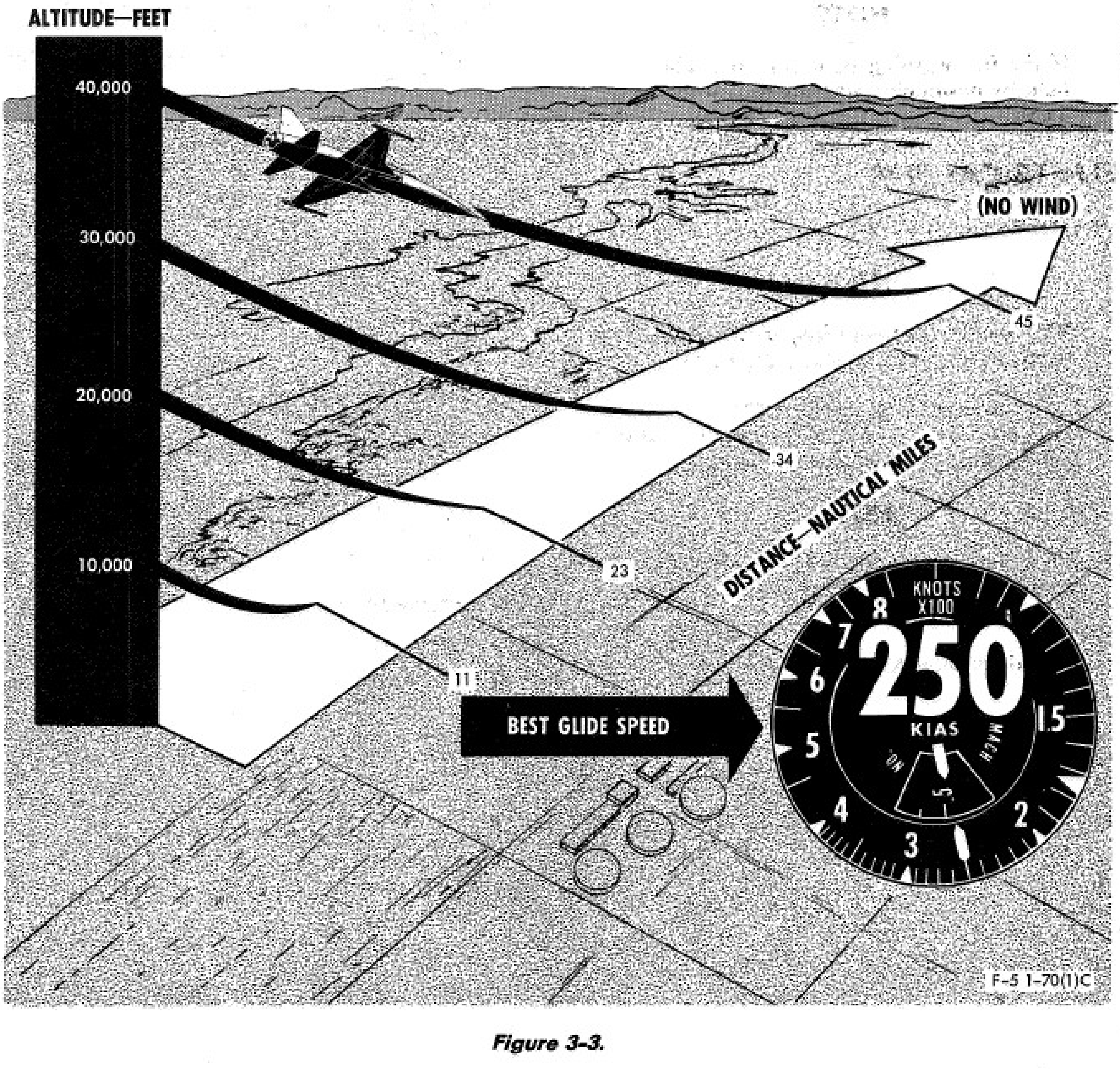


Figure 3-3.

FIRE WARNING IN FLIGHT (Affected Engine)

1. THROTTLE—IDLE.
2. THROTTLE—OFF IF FIRE WARNING LIGHT REMAINS ON.
3. IF FIRE IS CONFIRMED—EJECT.

WARNING

Close fuel shutoff switch if engine failed to shut down with throttle or fire warning light remains on.

NOTE

If the fire warning light goes out, check light by positioning warning test switch to TEST.

ELECTRICAL FIRE

1. Battery and Generator Switches—OFF.

NOTE

With fuel boost pumps inoperative, engine flameout may occur if above 25,000 feet.

2. All Electrical Equipment—OFF.
3. Battery and Generator Switch(es)—BATT and L GEN/R GEN (as required).

NOTE

Turn on battery and generator(s) and operate only those units necessary for flight and landing.

4. Land As Soon As Practical.

SMOKE, FUMES, OR ODOR IN COCKPIT

All odors not identifiable should be considered toxic. If smoke, fumes, or odor is detected in cockpit:

1. Oxygen—100%.
2. Check for Fire.
3. Descend to 25,000 Feet or Below.
4. Oxygen Emergency Lever—EMERGENCY.
5. Cockpit Pressurization Switch—RAM DUMP.
6. (F) [E-1] Cockpit Pressurization Switch—DEFOG ONLY (after smoke clears).
7. If Smoke Is Severe—Jettison Canopy Below 300 KIAS (if possible).

ENGINE MALFUNCTIONS

OIL PRESSURE

If pressure exceeds limits or a sudden change in pressure of 10 psi or more occurs:

1. Throttle—Reduce (to maintain pressure within limits).
2. Throttle—OFF (if engine seizure indicated).

CAUTION

Failure of engine rpm indication and loss of oil pressure on the same engine may be an indication of a sheared oil pump shaft. Consideration should be given to shutdown of the affected engine.

COMPRESSOR STALL

If an engine compressor stalls, proceed as follows:

1. Throttle—Retard (until engine recovers).
2. Increase Airspeed and Advance Throttle Slowly.

NOTE

If engine FOD is suspected, slow throttle advance is necessary to regain sustained engine power.

ENGINE MALFUNCTIONS (Continued)

3. Throttle—OFF (if engine will not recover).

NOTE

- After experiencing a compressor stall, the engine may not recover to the full range of operation. If normal instrument indications can be achieved for a given power setting, the engine should not be shut down unless other circumstances dictate.
- If the engine is shut down, an airstart may be attempted as applicable.
- Rapidly retarding the throttle to IDLE and immediately pushing the engine start button may permit the engine to recover and prevent complete flameout.

NOZZLE FAILURE

If nozzle failure occurs in closed range, excessive EGT is possible. If this condition occurs, follow the engine overtemperature procedure. If a nozzle fails in the open position, low EGT will result. The affected engine will operate from IDLE to MIL, but with a lower thrust output. Afterburner may not be available. Depending on the severity of either condition, consideration should be given to recovering the aircraft in accordance with single engine landing procedures. After landing, monitor EGT.

OVERSPEED OR OVERTEMPERATURE

If engine rpm exceeds 103% or egt exceeds 675°C during stabilized engine operation:

1. Throttle—Retard (until indication within limits).

LOSS OF CANOPY

1. Slow Aircraft to 300 KIAS or Less.

NOTE

Ⓔ Wind blast effect may be sufficient to cause circuit breakers to "pop" in the upper aft cockpit area. These circuit breakers are inaccessible during flight, and the resultant loss of associated electrical equipment may significantly affect normal aircraft operation.

ELECTRICAL SYSTEM FAILURE

AC FAILURE

Turn off unnecessary electrical loads. Operate only systems necessary for flight and landing. Conserve battery power.

1. Throttle(s)—Reduce RPM (if above 25,000 feet).
2. Battery Switch—BATT (check).
3. Generator Switch(es)—RESET, then L GEN/R GEN.
   Hold switch(es) at RESET momentarily before placing at L GEN/R GEN.
4. Altitude—25,000 Feet or Below.
5. Crossfeed—As Required.
6. Land As Soon As Possible.

NOTE

- In the event of single generator failure and failure of the remaining generator to pick up the load (power transfer failure), refer to electrical systems diagram.
- With fuel boost pump inoperative, remain below 25,000 feet. Although flight at reduced power can usually be sustained at altitudes up to 25,000 feet, fly at the lowest practical altitude for terrain clearance and range requirements.

DC OVERLOAD Ⓕ [E-1]

If the DC OVERLOAD caution light (figure 3-8) comes on in flight, use the following procedures:

1. Nonessential DC equipment—Turn Off (in increments).
2. Battery Switch—Cycle OFF/BATT (after each dc equipment reduction). Light should go off when dc is sufficiently reduced.

If Light Remains On

If DC OVERLOAD caution light remains on after all possible dc reductions, the overload detector may have malfunctioned, or the battery may be charging excessively. Proceed as follows:

1. Essential DC Equipment—As Required.
2. Land As Soon As Practical.

COMPLETE ELECTRICAL FAILURE

1. Battery and Generator Switches—Check (BATT and L GEN/R GEN).
2. Circuit Breakers—Check.

ELECTRICAL SYSTEM FAILURE (Continued)

The Following are Inoperative

a. Flight and Engine Instruments (except tachometers, AAU-19/A, AAU-34/A altimeter in standby mode, and standby attitude indicator for 9 minutes duration).
b. Communications and Navigation Equipment.
c. Speed Brake and Flaps.
d. Landing Gear Normal Extension.
e. Landing Gear Indicator Lights.
f. Nosewheel Steering.
g. Fuel Boost Pumps.
h. Engine Ignition System.
i. Emergency All and Select Jettison Controls.
j. Anti-ice Systems.
k. External Fuel (unless selected prior to failure).
l. Stability Augmenter System.
m. Pitch and Aileron Trim.
n. Arresting Hook Extension.
o. Canopy Seal May Not Deflate.

FUEL AUTOBALANCE SYSTEM MALFUNCTION

If fuel autobalance system malfunction occurs (switch failed in LEFT LOW or RIGHT LOW position), proceed as follows:

1. Auto Balance Switch—Center (manually).
2. Fuel Balancing—Use Manual Procedures (as required).

If Auto Balance Switch Cannot be Moved

1. Altitude—25,000 Feet or Below.
2. Crossfeed Switch—CROSSFEED.
3. Fuel Boost Pump (on low side)—OFF.

NOTE

- Accomplishing this procedure will turn off the fuel boost pump of the low fuel side, thus initiating gravity feed. With this failure mode, the manual system will not override the automatic system until actuation of the fuel low caution signal. At that point, the auto balancing system will be bypassed and the manual balancing system will operate. When the systems are balanced, terminate manual fuel balancing.
- Flight with reduced power at lowest practical altitude for terrain clearance and emergency requirements will further assure continued stable engine operation with boost pumps inoperative.

4. Land As Soon As Practical.

HYDRAULIC SYSTEMS FAILURE

DUAL SYSTEM FAILURE
If Flight Control Becomes Impossible

1. Eject.

SINGLE SYSTEM FAILURE
If Utility or Flight Hydraulic Caution Light Illuminates

1. Hydraulic Pressure Indicators — Check.

With Hydraulic Pressure Low

1. Monitor Both Systems.
2. Pitch and Yaw Damper Switches — OFF (utility only).
3. Land As Soon As: Possible — Both Systems. Practical — One System.

With Hydraulic Pressure High

A steady-state hydraulic pressure higher than 3200 psi in either system must be considered a system malfunction; proceed as follows:

1. Land As Soon As Possible.
2. Retard Throttle of Affected Engine to IDLE.
3. Pitch and Yaw Damper Switches — OFF (utility only).
4. Minimize Flight Control Movement.
5. Land From a Straight-In Approach.
6. Clear of Runway, Shut Down Affected Engine.

With a Flight Control Malfunction (Sluggish Controls)

If a high hydraulic pressure reading in either system is accompanied by sluggish flight controls or other symptoms of a flight control system malfunction, proceed as follows:

1. Shut Down Affected Engine.
2. Minimize Flight Control Movements.
3. Land As Soon As Possible.
4. Land From a Straight-In Approach.
5. If Control Becomes Difficult or Impossible — Eject.

HYDRAULIC SYSTEMS FAILURE (Continued)

Inoperative Equipment With Utility Hydraulic System Failure

a. Landing Gear Normal Extension.
b. Nosewheel Steering.
c. Normal Brakes.
d. Speed Brake.
e. Stability Augmenter.
f. Gun Gas Deflector and Purge Doors.

AIRFRAME GEARBOX FAILURE

A gearbox failure is indicated by simultaneous illumination of the generator and hydraulic caution lights for the same engine.

If Gearbox Fails

1. Throttle (affected engine) — OFF (if vibration exists).

Gearbox failure to shift is indicated when either generator caution light comes on when accelerating thru the 68% to 72% shift range.

If Gearbox Fails to Shift

1. Throttle—Reduce RPM (to range which will sustain generator operation).
2. Generator Switch—RESET, then L GEN/R GEN, if necessary.
3. Throttle—Maintain RPM (in range sustaining generator operation until starting final approach, then use as necessary to effect a safe landing).

TRIM MALFUNCTION

PITCH TRIM FAILURE

Pitch trim may fail completely or in only one direction. Exercise caution to preclude activation of pitch trim to an extreme position from which it cannot be returned. A controllability check should be accomplished at a safe altitude in a landing configuration.

1. Airspeed—Adjust (as necessary to minimize stick forces).
2. Pitch Trim—Set As Required.
3. Flaps—As Required.
   The flap/horizontal tail interconnect allows some horizontal tail movement with normal pitch trim inoperative.
4. Landing Approach—Straight In (if possible).

RUNAWAY TRIM

1. Trim Control—Actuate in Opposite Direction.

If Runaway Trim Is Not Corrected

2. TRIM CONTROL Circuit Breaker (Left Console Circuit Breaker Panel; Ⓕ front cockpit)—Pull.

PITCH DAMPER FAILURE (WITH EXTERNAL TANKS)

1. Airspeed—Reduce Below 0.75 IMN.

Ⓔ Normal operation of the stability augmenter system becomes more critical when external tanks are carried on inboard wing stations, particularly in the absence of outboard stores without full ammunition ballast.

CONTROLLABILITY CHECK

1. Altitude—15,000 feet AGL (if practical).
2. Landing Configuration—Establish.

NOTE

Minimize flap movement if flap damage is known or suspected.

3. Airspeed—Reduce.
   Airspeed should be reduced to determine the acceptable approach and landing characteristics (no slower than normal approach speed).
4. Gear and Flaps—Landing Configuration (as determined).
5. Do Not Change Aircraft Configuration.
6. Landing Approach—Straight In.
   Plan to fly a power-on, straight-in approach requiring minimum flare. Fly final approach no slower than acceptable airspeed determined in step 3.
7. Touchdown—At or Above Determined Airspeed.

ERECT POSTSTALL GYRATION RECOVERY

Poststall gyration (PSG) is characterized by uncommanded motion at angles of attack (AOA) above stall. The dominant characteristic is an uncommanded yaw excursion at stall, followed quickly by roll oscillations. These motions tend to increase the angle of attack. Exaggerated full aft stick rudder rolls can similarly drive AOA above

ERECT POSTSTALL GYRATION RECOVERY (Continued)

stall. Uncommanded yaw excursions may continue after rudder is neutralized and result in a PSG. When uncommanded motion is sensed, aft stick pressure should be relaxed to reduce AOA. If relaxing aft stick pressure does not immediately recover the aircraft, take the following action:

1. STICK—FORWARD (As Required).
2. Ailerons and Rudder—Neutral.

NOTE

- In most cases, neutral ailerons and rudder with stick position forward of trim will initiate recovery from the PSG. However, if recovery is still not indicated, full forward stick should then be applied immediately.
- Recovery is indicated when the aircraft responds to forward stick and the AOA has been sustained below 25 units (momentary AOA indications below 30 units may be erroneous due to sideslip effects on the AOA vane). Once recovery is indicated, relax forward stick to prevent an overshoot to negative g.

WARNING

Failure to relax forward stick on recovery may cause the aircraft to enter an inverted PSG or inverted spin.

NOTE

During more severe PSGs, one or both engines may flame out. The probability of flameouts is increased with engines at MIL or MAX power.

If an erect spin is recognized, maintain full forward stick and proceed with the erect spin recovery procedures.

ERECT SPIN RECOVERY

Initially, the spin will be oscillatory about all axes. Spin rotation may be slow, and roll oscillations may mask the yawing to the extent that determination of spin direction is difficult. Full forward stick may be sufficient to recover the airplane during this initial part of the spin. However, as the spin develops, it may transition from the oscillatory mode, which may be recoverable, to a flat spin from which recovery is very unlikely. Therefore, immediately upon recognition of spin direction, the following spin recovery controls should be applied:

1. STICK—FULL FORWARD.
2. AILERON—FULL IN DIRECTION OF SPIN.
3. RUDDER—FULL OPPOSITE.
4. Flaps—Maneuver.

WARNING

Do not sacrifice forward stick or recovery aileron to select maneuver flaps. Failure to maintain primary recovery controls may prolong or prevent recovery.

5. Neutralize Controls After Recovery. Do not change gear and speed brake positions during recovery.

NOTE

Recovery from an erect spin is slow and may require several turns. As the airspeed increases to approximately 130 knots, the nose abruptly pitches down and yaw rate ceases. There will likely be some residual rolling immediately following spin recovery.

WARNING

- If full aileron deflection (thru the spring stop) in the direction of the spin is not maintained thruout the recovery, the spin recovery may be prolonged or prevented. Only half aileron deflection is available at the spring stop. Both hands may be required to force the stick past the spring stop.
- The pitch-over during recovery from an erect spin is abrupt. Smooth aft stick is required to prevent an overshoot to negative g.
- Deployment of drag chute for spin recovery purposes is not recommended.

INVERTED POSTSTALL GYRATION/ INVERTED SPIN RECOVERY

An inverted poststall gyration/spin is characterized by violent, disorienting oscillations about all three axes following an inverted stall. Maneuver flaps and/or aft cg tend to expedite an inverted PSG/ spin entry. The motion is dominated by the large pitch oscillations but has roll and yaw oscillations superimposed. The aircraft will continue to pitch, roll, and yaw violently in what appears to be a random manner, and the pilot will continuously experience negative g's. Although not recognizable to the pilot, this is an inverted spin. If an inverted PSG/spin is encountered, immediately accomplish the following:

1. **FLAPS—UP.**
2. **STICK—AFT (As Required).**
3. **AILERONS AND RUDDER—NEUTRAL.**

NOTE

If the aircraft does not recover to positive-g flight after flaps are UP, smooth aft stick should be applied as necessary to regain positive-g flight.

WARNING

- The aircraft will always recover from the inverted PSG/spin but some additional negative pitch oscillations (typically 1 to 3) may be encountered prior to recovery. If recovery is initiated at airspeeds below approximately 100 KIAS, some delay may be encountered before effectiveness of flight control surfaces is regained.
- If considerable aft stick is used to recover from the inverted PSG/spin, the aircraft can very quickly transition to an extreme positive AOA upon recovery to a positive-g flight. This could lead to an erect PSG/ spin.
- Avoid aileron and rudder deflection until positive-g flight and airspeed above the stall are regained. These controls can induce transition to an upright (erect) PSG/spin.
- If control is not regained from an erect or inverted spin by *15,000* feet AGL, eject.

EJECTION VS FORCED LANDING

Ejection is preferable to landing on an unprepared surface. Landing with both engines flamed-out will not be attempted.

EJECTION (GENERAL)

The Standard ejection seat system provides safe escape during level flight (no sink rate) from ground level (with 0-second parachute) to maximum flight altitude and from 120 KIAS to 550 KIAS (400 KIAS with zero-delay lanyard attached) (BA-22 parachute) (see figures 3-4, 3-5, and 3-7). The Improved ejection seat system provides safe escape during level flight (no sink rate) from ground level (with 0.25-second BA-25A parachute) to maximum flight altitude and from 50 KIAS to 500 KIAS. (See figures 3-4, 3-6, 3-8, and 3-9). However, many variables that can reduce survival chances and most are cumulative. They include altitude, airspeed, pitch and bank angles, sink rate, g-loads, human reaction times, etc. In most situations, ejection at higher altitudes (approximately 10,000 feet AGL) at reduced airspeed compensates for these variables and allows more time to overcome any ejection difficulties.

EJECTION ALTITUDE

Chances for survival are better if ejection occurs above 2000 feet AGL flying straight and level at a low airspeed. When the aircraft is controllable at higher altitudes, trade excess airspeed and excess altitude for time to accomplish before ejection procedures. When below 2000 feet AGL, trade airspeed for altitude in a zoom maneuver and eject before climb rate reaches zero. Under uncontrolled conditions (spins, dives, etc,) eject at least *15,000* feet AGL whenever possible.

WARNING

- If the aircraft becomes uncontrollable below *15,000* feet AGL, eject immediately since any delay reduces your chances for successful ejection.
- Do not delay ejection below 2000 feet above the terrain for any reason that may commit you to an unsafe ejection or a dangerous flameout landing. Accident statistics show a decrease in successful ejections as altitude decreases below 2000 feet AGL.

EJECTION (GENERAL) (Continued)

LOW ALTITUDE EJECTION

The minimum emergency ejection conditions based on level attitude with no sink rate are as follows:

STANDARD SEAT WITH BA-22 PARACHUTE
(1-Second Automatic-Opening Safety Belt)

1-Second Parachute (Lanyard disconnected)	Altitude—100 Feet
0-Second Parachute (Lanyard attached)	Ground Level—120 KIAS

IMPROVED SEAT WITH BA-25A PARACHUTE
(0.65-Second Automatic-Opening Safety Belt)
Ground Level at 50 KIAS

WARNING

No safety factor is provided for equipment malfunction. Since survival from an extremely low altitude ejection depends on the aircraft sink rate, attitude, and altitude, the decision to eject under these conditions must be left to the pilot. Factors such as g-loads, high sink rate, and, while at low altitudes, aircraft attitudes other than level or slightly nose high will decrease survival chances. The emergency minimum of 120 KIAS for Standard seat or 50 KIAS for Improved seat at ground level is given only to show that zero altitude ejection can be accomplished. It must not be used as a basis for delaying ejection when above 2000 feet AGL.

BEFORE EJECTION

Prior to ejection at low altitudes, attempt to level the wings and zoom the aircraft. If at high altitude, set up a speed and configuration that obtain maximum glide distance or recommended speed for engine airstart.

WARNING

- Engines require 25 seconds to develop usable thrust from minimum airstart rpm.
- Eject before the start of any sink rate. If a high sink rate occurs, eject immediately.

Under controlled conditions, attempt to slow the aircraft as much as practical prior to ejection by trading airspeed for altitude. Ejection should be accomplished while in a positive rate-of-climb with the aircraft attitude approximately 20 degrees nose up. Also, if a positive rate-of-climb cannot be achieved, level flight ejection should be accomplished immediately to avoid ejection with a sink rate.

WARNING

- If the aircraft is not controllable, ejection must be accomplished at whatever speed exists, as this offers the only opportunity of survival. At sea level, wind blast and deceleration will exert medium forces on the body up to approximately 450 KIAS, severe forces causing flailing and skin injuries between 450 and 600 KIAS, and excessive forces above 600 KIAS. As altitude increases, the speed ranges of the injury-producing forces will be a function of the mach number.
- The automatic seat belt must not be opened manually before ejection, regardless of altitude, as this will eleiminate the automatic features of the parachute.

If time and conditions permit, accomplish as much of the following as possible:

1. Ⓕ Notify Other Crewmember of Decision to Eject.
2. Ⓕ Verbally Verify Setting Of Ejection Sequence Selector.

WARNING

If selector is at NORMAL or DUAL, ensure legbraces in both cockpits are raised before ejection.

3. Turn IFF to EMERGENCY, UHF to GUARD; Transmit MAYDAY, Giving Position and Intentions.
4. Turn Aircraft Toward Uninhabited Area.
5. Attain Proper Airspeed, Altitude, and Attitude.
6. Stow Loose Gear and Ⓕ Instrument Hood.
7. (High Altitude) Actuate Emergency Oxygen Cylinder.
8. Locator Beacon Actuator Tab—As Required.
9. (Improved Survival Kit) AUTO/MANUAL Selector—As Required.
10. Lock Shoulder Harness, Lower Helmet Visor, and Tighten Chin Strap, Seat Belt, and Survival Kit Straps.

EJECTION (GENERAL) (Continued)

11. Zero Delay Lanyard (BA-22)—Check.

EJECTION

See figure 3-4 for ejection procedure.

AFTER EJECTION

Immediately After Ejection

1. Safety Belt—Attempt to Open Manually.
   Attempt to manually open the safety belt as a precaution against the belt failing to open automatically.

WARNING

If the safety belt is manually opened, all subsequent automatic features are lost. Immediately push away from seat and pull arming lanyard if above 14,000 feet or ripcord if below 14,000 feet.

NOTE

It is impossible to beat the automatic safety belt/separator system if it functions properly. If the system should malfunction, immediately attempt to separate manually in the least possible time.

2. Safety Belt Released—Attempt to Separate from Seat.
   As soon as the belt releases, a determined effort must be made to separate from the seat to obtain full parachute deployment at maximum terrain clearance. This is extremely important for low altitude ejections.
3. If Safety Belt is Opened Manually—Immediately Pull Parachute Arming Lanyard if Above 14,000 feet or Ripcord Handle if Below 14,000 feet.
4. Survival Kit—After Chute Stabilizes, Deploy Kit, If Attached.

WARNING

In the case of expected tree landing, delay release of survival kit until at rest or clear of trees to avoid rope entanglement or possible loss of kit. Landing on the ground with survival kit attached, however, may cause personal injury.

After chute stabilization and survival kit deployment, the four-line release should be made if oscillations persist. The resulting increase in horizontal velocity will be reduced by facing into the wind. Release canopy as soon as practical after landing. The life vest should be inflated before water landing.

EJECTION

WARNING

- ASSUME PROPER POSITION. SIT ERECT, HEAD FIRMLY AGAINST HEADREST, CHIN TUCKED IN, FEET HELD BACK AGAINST SEAT. POSITION ELBOWS CLOSE TO BODY WITHIN ELBOW GUARDS, TO PROTECT ELBOWS WHEN LEGBRACES ARE RAISED AND DURING EJECTION.
- IF SEAT IS ADJUSTED TOO HIGH, IT MAY BE IMPOSSIBLE TO ASSUME EJECTION POSITION.
- (F) TO PREVENT POSSIBLE INJURY FROM FRONT SEAT ROCKET BLAST, REAR CREWMEMBERS SHOULD EJECT FIRST IF ALTITUDE PERMITS. IF BOTH SEATS ARE OCCUPIED, ENSURE LEGBRACES OF EACH SEAT ARE RAISED BEFORE SQUEEZING TRIGGER.

1 HANDGRIPS–RAISE

USING ONE OR BOTH HANDGRIPS, RAISE LEGBRACES UNTIL LOCKED AND TRIGGERS ARE EXPOSED.

2 TRIGGERS–SQUEEZE

SQUEEZING ONE OR BOTH TRIGGERS JETTISONS CANOPY AND EJECTS SEAT. SEAT WILL EJECT THRU CANOPY IF CANOPY FAILS TO JETTISON.

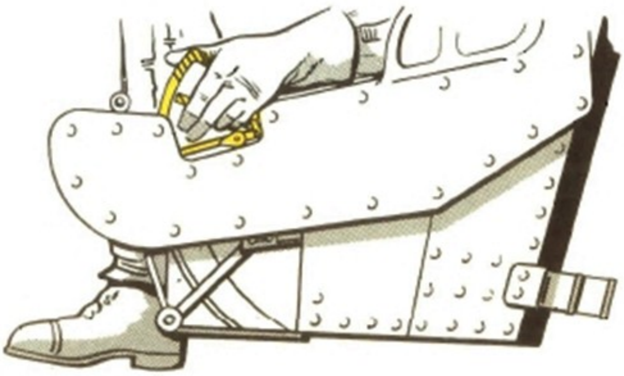


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Figure 3-4.

EJECTION SEQUENCE

STANDARD SEAT
(BA-22 PARACHUTE)

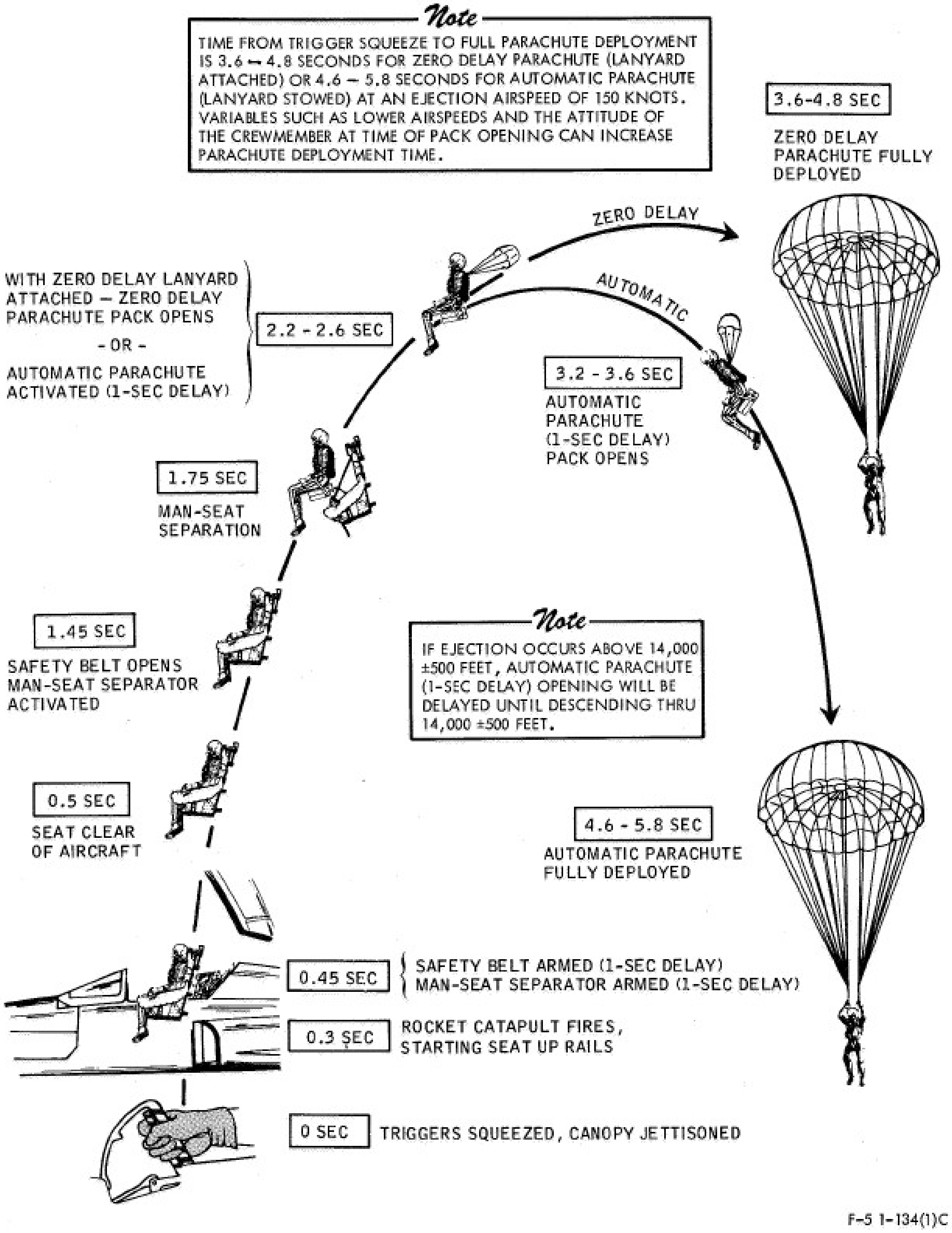


Figure 3-5.

EJECTION SEQUENCE

IMPROVED SEAT
(BA-25A PARACHUTE)

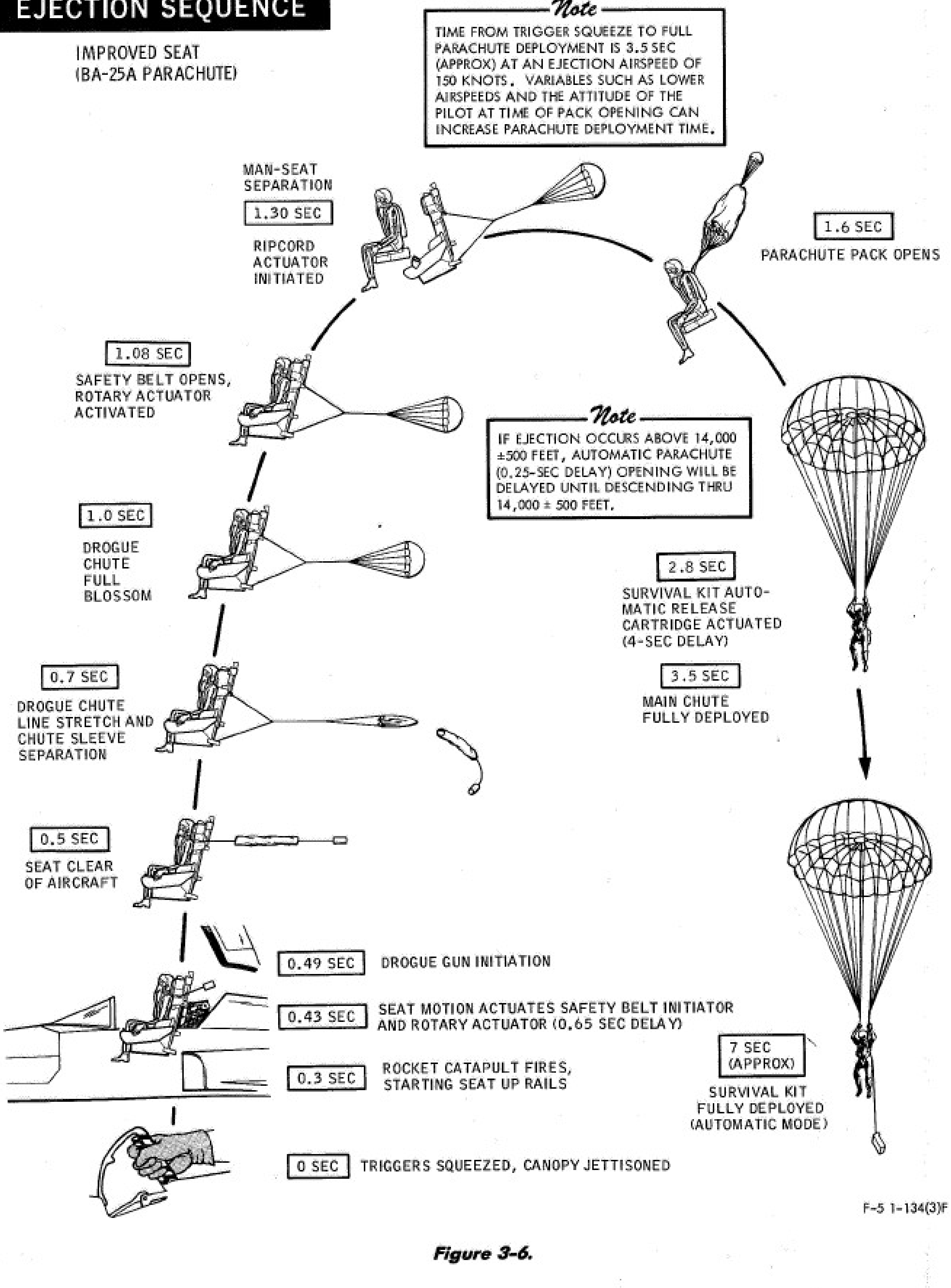


Figure 3-6.

EJECTION ALTITUDE VS SINK RATE & DIVE/BANK ANGLE

STANDARD SEAT

Note

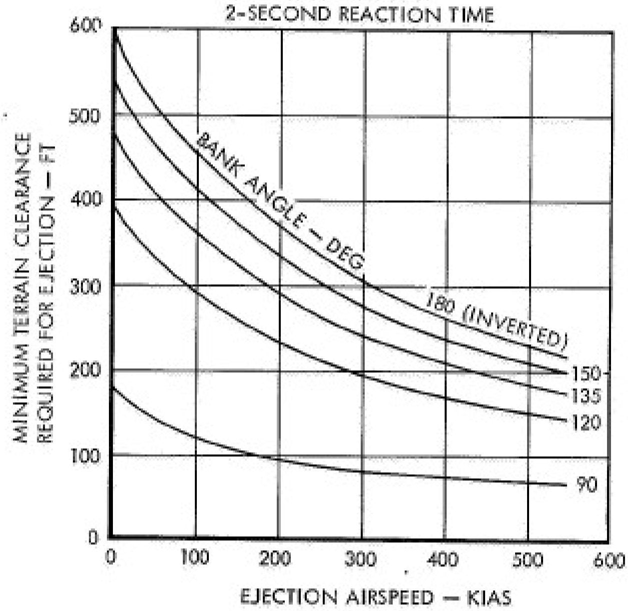
SEAT EQUIPPED WITH BA-22 PARACHUTE, M-38 ROCKET CATAPULT, AND 3.6 TO 4.8-SECOND SYSTEM (TRIGGER SQUEEZE TO FULL PARACHUTE DEPLOYMENT).

WARNING

- THE MINIMUM EJECTION ALTITUDES SHOW SEAT CAPABILITY (WITH 2-SECOND REACTION TIME) AS AFFECTED BY AIRCRAFT SINK RATE, BANK ANGLE, AND DIVE ANGLE. THE MINIMUM ALTITUDES DO NOT PROVIDE ANY SAFETY FACTOR FOR EQUIPMENT MALFUNCTION OR DELAY IN SEPARATING FROM THE SEAT.
- EJECTIONS BELOW BANK ANGLE OR DIVE ANGLE LINES ARE UNSAFE FOR GIVEN CONDITIONS.
- THE MINIMUM EJECTION ALTITUDES SHALL NOT BE USED AS THE BASIS FOR DELAYING EJECTION WHEN ABOVE 2000 FEET TERRAIN CLEARANCE.

CONDITIONS

CONSTANT ALTITUDE
2-SECOND REACTION TIME



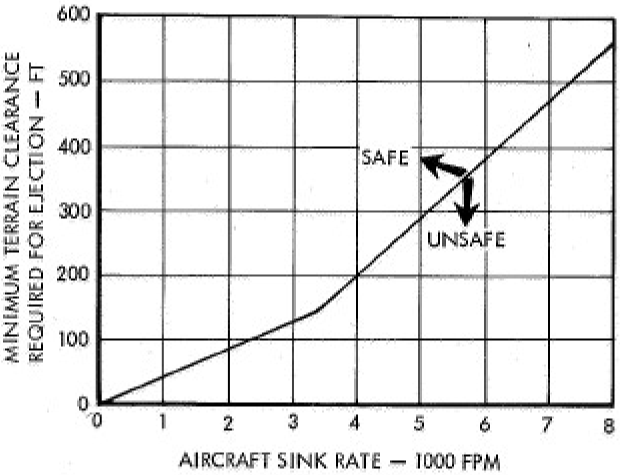
Note

BANK ANGLES UP TO 60° ARE SAFE FOR EJECTION AT ALL AIRSPEEDS WITHIN THE EJECTION ENVELOPE.

BANK ANGLE

CONDITIONS

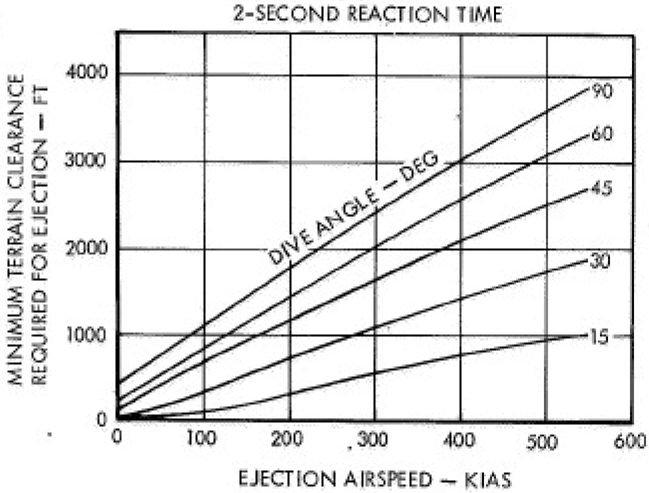
ZERO DELAY LANYARD ATTACHED
AIRSPEED AT EJECTION — 150 KNOTS
WINGS LEVEL — SLIGHT NOSE UP ATTITUDE
2-SECOND REACTION TIME



SINK RATE

CONDITIONS

WINGS LEVEL
2-SECOND REACTION TIME



DIVE ANGLE

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Figure 3-7.

EJECTION ALTITUDE VS BANK/DIVE ANGLE

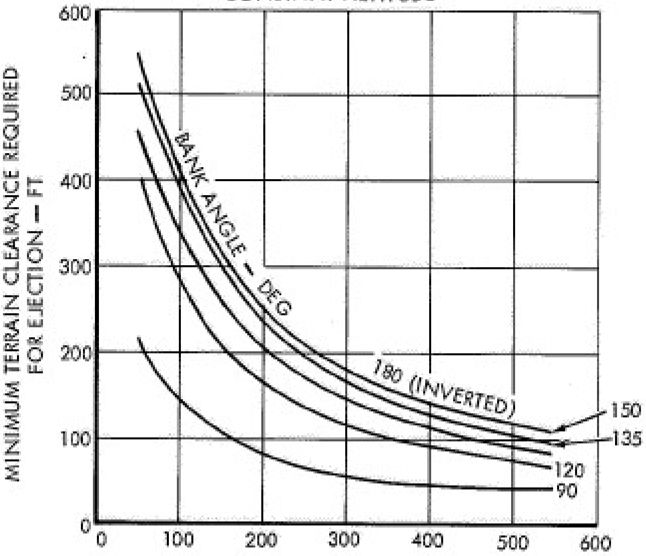
IMPROVED SEAT

WARNING

- THE MINIMUM EJECTION ALTITUDES SHOW SEAT CAPABILITY (WITH 2-SECOND REACTION TIME) AS AFFECTED BY BANK ANGLE AND DIVE ANGLE. THE MINIMUM ALTITUDES DO NOT PROVIDE ANY SAFETY FACTOR FOR EQUIPMENT MALFUNCTION OR DELAY IN SEPARATING FROM THE SEAT.
- EJECTIONS BELOW BANK ANGLE OR DIVE ANGLE LINES ARE UNSAFE FOR GIVEN CONDITIONS.
- THE MINIMUM EJECTION ALTITUDES SHALL NOT BE USED AS THE BASIS FOR DELAYING EJECTION WHEN ABOVE 2000 FEET TERRAIN CLEARANCE.

CONDITIONS

2-SECOND REACTION TIME
CONSTANT ALTITUDE



BANK ANGLE

Note

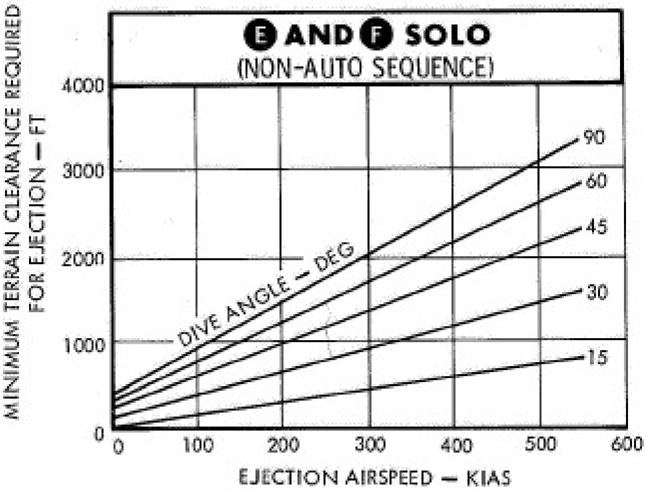
BANK ANGLES UP TO 60° ARE SAFE FOR EJECTION AT ALL AIRSPEEDS WITHIN THE EJECTION ENVELOPE.

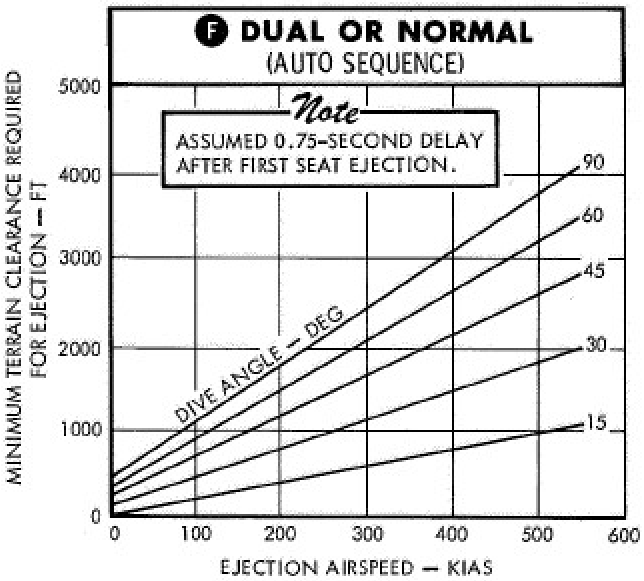
Note

SEAT EQUIPPED WITH BA-25A PARACHUTE, M-38 OR CKU-7A ROCKET CATAPULT, AND 3.5 SECOND SYSTEM (TRIGGER SQUEEZE TO FULL PARACHUTE DEPLOYMENT).

CONDITIONS

WINGS LEVEL
2-SECOND REACTION TIME





DIVE ANGLE

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Figure 3-8.

EJECTION ALTITUDE VS SINK RATE

IMPROVED SEAT

WARNING

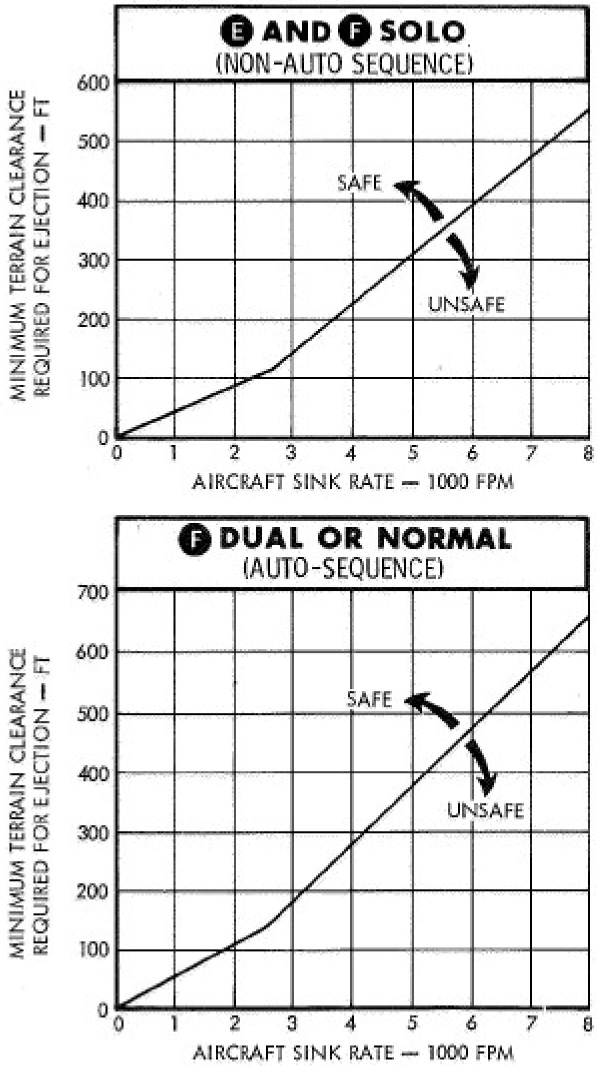
- THE MINIMUM EJECTION ALTITUDES SHOW SEAT CAPABILITY (WITH 2-SECOND REACTION TIME) AS AFFECTED BY AIRCRAFT SINK RATE. THE MINIMUM ALTITUDES DO NOT PROVIDE ANY SAFETY FACTOR FOR EQUIPMENT MALFUNCTION OR DELAY IN SEPARATING FROM THE SEAT.
- THE MINIMUM EJECTION ALTITUDES SHALL NOT BE USED AS THE BASIS FOR DELAYING EJECTION WHEN ABOVE 2000 FEET TERRAIN CLEARANCE.

Note

- SEAT EQUIPPED WITH BA-25A PARACHUTE, M-38 OR CKU-7A ROCKET CATAPULT, AND 3.5-SECOND SYSTEM (TRIGGER SQUEEZE TO FULL PARACHUTE DEPLOYMENT).
- (F) REAR SEAT EJECTS FIRST, FOLLOWED IN 0.75 SECOND BY FRONT SEAT (AUTO-SEQUENCE EJECTION).

CONDITIONS

AIRSPEED AT EJECTION — 150 KIAS
WINGS LEVEL — SLIGHT NOSE-UP ATTITUDE
2-SECOND REACTION TIME

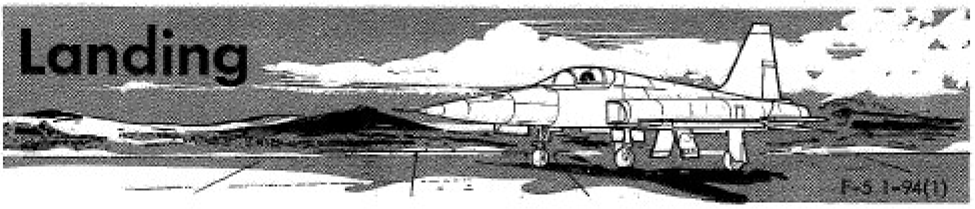


SINK RATE

F-5 1-140(1)F

Figure 3-9.

THIS PHASE OF OPERATION IS FROM THE INITIATION OF THE LANDING PROCEDURE THRU THE LANDING ROLL.



DRAG CHUTE FAILURE

If the drag chute fails to deploy on landing, and the decision is made to go around, use the following procedure:

1. Drag Chute—Jettison.
2. Go Around.
   See Go-Around procedures in section II.

SINGLE-ENGINE APPROACH

Delay lowering landing gear until just before glide path. MAX thrust should be used on single-engine approaches if necessary.

WARNING

Expend or jettison stores before entering the landing pattern, if necessary.

SINGLE-ENGINE LANDING

1. Flap Thumb Switch—M.
2. Gear—Down.

NOTE

Windmilling rpm may be sufficient to allow normal extension of landing gear. However, if gear does not extend, use alternate release system to extend gear. Safe gear extension may take as long as 35 seconds. Nosewheel steering and normal braking will not be available.

3. Airspeed—Increase 10 KIAS above Normal Until Landing Assured.
4. Ⓔ AOA Indicator—14.0 Units on Final Approach.
5. Ⓕ AOA Indicator—Monitor. Do Not Exceed Normal AOA.
6. Drag Chute—As Required.

SINGLE-ENGINE MISSED APPROACH

Use MAX thrust for single-engine missed approach. Landing gear should be retracted as soon as 10 knots above safe single-engine takeoff speed is attained and climb is established. Keep flaps in maneuver and accelerate in MAX thrust. Climb at 260 KIAS with landing gear up or 210 KIAS with landing gear down. See appendix I for single-engine maximum thrust climb gradient at 50-foot obstacle clearance speed.

WING FLAP ASYMMETRY

If lateral rolling and yawing is experienced during operation of the wing flaps, an asymmetric wing flap condition probably exists. If this occurs, immediately return flap thumb switch/lever to the previous setting. If lateral rolling and yawing continues, extend landing gear to allow full aileron control. Time permitting, a controllability check should be made at a safe altitude to determine safe minimum airspeeds to use in the landing pattern. In any event, airspeeds should be increased at least 20 knots above normal pattern approach and landing speeds. Leading edge flap asymmetry should not present a control problem as little rolling and yawing effect is induced if the aircraft is not at a high angle of attack.

NO-FLAP LANDING

If a landing is to be made with the wing flaps retracted, use the normal landing procedure modified as follows:

1. Pattern—Fly Wider than Normal.
2. Airspeed—Increase by 10 KIAS the Final Turn, Final Approach, and Touchdown Airspeeds.
3. Ⓔ AOA Indicator—16.4 Units on Final Approach.
4. Ⓕ AOA Indicator—Do Not Use.

NO-FLAP LANDING (Continued)

NOTE

Landing distance will increase approximately 15% due to higher touchdown speed and less effective aerodynamic braking.

LANDING GEAR ALTERNATE EXTENSION

1. Airspeed—260 KIAS or Less.
2. Gear Lever—LG DOWN.
3. Alternate Release Handle—Pull.
   Pull handle out and hold (approximately 10 inches) until gear unlocks; then stow.
4. Gear Indicators—Check.

NOTE

- If the main gear fails to extend fully, yawing the aircraft, rocking wings, and pulling positive G's will aid in the extension.
- Nosewheel steering will not be available.
- Stop straight ahead on the runway and have the landing gear safety pins installed.

If Alternate Extension Fails

If alternate extension fails to extend landing gear, the landing gear door selector valve may have failed, indicated by excessive handle forces and failure of handle to fully extend. The landing gear will not extend because trapped hydraulic pressure from the utility hydraulic system holds the gear doors and uplocks in the gear up position. Dissipating the pressure will allow the gear to extend. To dissipate hydraulic pressure and extend the landing gear:

1. Throttle (left engine)—OFF.
2. Gear Lever—Check at LG DOWN.
3. Control Stick—Rapid lateral stick movements (until utility hydraulic pressure depleted).
4. Alternate Release Handle—Pull.
   Pull handle out fully while pressure is depleted until gear unlocks; then stow.
5. Gear Lever—LG UP, then LG DOWN (cycle rapidly).
6. Gear Indicators—Check.
7. Left Engine—Restart.

NOTE

If gear indicates unsafe after utility hydraulic pressure builds up, gear will not remain down because the gear selector valve has failed or the landing gear control circuit has malfunctioned.

If Gear Remains Unsafe

8. Battery and Generator Switches—OFF (if required).
9. Alternate Release Handle—PULL.
   Hold until gear unlocks, then stow.
10. Battery and Generator Switches—BATT and L GEN/R GEN.
11. Gear Indicators—Check.

LANDING GEAR EXTENSION FAILURE

A landing with gear up or unsafe requires careful consideration before deciding whether to attempt a landing or eject. The following table indicates that for a particular gear condition, a landing is considered feasible, or ejection is the best course of action.

GEAR CONDITION		RECOMMENDED ACTION
NOSE	MAIN	
UP	BOTH DOWN	LAND
UP	BOTH UP	EJECT (unless carrying empty CL pylon tank or empty SUU-20 and/or empty symmetrical wing tanks)
UP	ONE DOWN	EJECT
DOWN	BOTH UP	
DOWN	ONE DOWN	

LANDING GEAR EXTENSION FAILURE (Continued)

WARNING

- Landing in lieu of ejection for gear conditions recommending ejection is considered more hazardous.
- Pilot injury may result if belly landing is attempted without empty tank(s) or empty SUU-20 to cushion shock of nose "slam-down."

Landings should always be made on a hard-surface runway. If all gear are fully down but one or more are indicating unsafe, stop straight ahead on the runway and have the gear safety pins installed. If time and conditions permit, take the following actions to reduce gross weight, minimize fire hazard, and provide a better sliding surface.

a. Request runway be foamed.
b. Expend excess fuel.
c. Jettison armament.
   Retain empty pylon tank(s) or empty SUU-20, using select jettison system.

Use normal approach and touchdown speeds for all configurations. Minimize rate of sink at touchdown but maintain a normal landing attitude to avoid excessive "slam-down." The procedures to be used for landing with gear extension failure are contained in the following paragraphs.

LANDING WITH NOSE GEAR UP OR UNSAFE

With both main gear extended and nose gear up or unsafe:

1. Shoulder Harness—LOCK.
2. Survival Kit—Disconnect.
   Pull kit emergency release handle.
3. Landing Pattern—Normal.
4. Throttles—IDLE at Touchdown.
5. Nose—Gently Lower to Runway.

NOTE

If nose gear is up, position throttles OFF when nose contacts runway.

6. Drag Chute—Deploy.
7. Wheel Brakes—As Required.

NOTE

Do not use brakes if a safe stop can be made without them when the nose gear is down but indicating unsafe.

8. Battery Switch—OFF.

BELLY LANDING

Without Empty Pylon Tank(s) and/or Empty SUU-20

1. Eject.

With Empty Pylon Tank(s) and/or Empty SUU-20

1. Landing Gear—UP.
2. Shoulder Harness—LOCK.
3. Survival Kit—Disconnect.
   Pull kit emergency release handle.
4. Landing Pattern—Normal.
5. Throttles—OFF at Touchdown.
6. Drag Chute—Deploy When Aircraft is on Runway.
7. Battery Switch—OFF.

LANDING WITH ONE OR BOTH MAIN GEAR NOT EXTENDED

If all attempts to have both main gear extended a[illegible] unsuccessful with nose gear up or down and gear cannot be retracted:

1. Eject.

If Landing Must be Attempted

1. Shoulder Harness—LOCK.
2. Survival Kit—Disconnect.
   Pull kit emergency release handle.
3. Landing Pattern—Normal.
4. Throttles—IDLE at Touchdown.

NOTE

With one main gear extended, touch down in center of runway; use aileron to hold wings level, nosewheel steering (if nose gear down), and brake on extended gear to maintain directional control.

5. Drag Chute—Deploy.
6. Throttles—OFF.
7. Battery Switch—OFF.

LANDING WITH TIRE FAILURE

NOSE GEAR

When landing is to be made with the nose gear tire flat, expend excess fuel, fire out ammunition, jettison CL store, if practicable to obtain a more favorable aft cg position before landing. Fly a normal traffic pattern. After touchdown, hold nosewheel off runway as long as possible. When nosewheel touches down, engage nosewheel steering and deploy drag chute. Make maximum use of rudder, nosewheel steering, and wheel braking to maintain directional control.

MAIN GEAR

When landing with a main gear tire flat is anticipated, expend excess fuel before landing. External stores should be jettisoned but empty pylon fuel tank(s) retained. Fly a normal traffic pattern. Touch down in the center of the runway. After touchdown, lower nosewheel to runway, engage nosewheel steering, deploy drag chute, and use a combination of rudder, nosewheel steering, and braking to maintain directional control.

DITCHING

Ditch only as a last resort. If unable to eject:

1. Distress Procedure—Radio, IFF/SIF.
2. Oxygen—100%.
3. Stores—Jettison.
4. Personal Equipment Leads—Disconnect (all except oxygen hose).
5. Shoulder Harness—LOCK.
6. Landing Gear—UP.
7. Speed Brake—Out.
8. Flap Lever—FULL.
9. Canopy(ies)—Jettison.
10. Normal Approach.
11. Throttles—OFF at Touchdown.
12. When Forward Motion Stops—Open Safety Belt and Disconnect Oxygen Hose.

ARRESTMENT

See Abort/Arrestment, this section, for mid-field and departure-end engagements.

APPROACH-END ENGAGEMENT

1. Landing Configuration—Establish.
2. Hook—Down.
3. AOA—On Speed.
4. Touchdown—500 feet (minimum) Before The Cable In Center of Runway.
5. Nose—Lower to Runway.
6. Chute—Deploy.
7. Braking—Discontinue.

CAUTION

- Counteract any rollback after arrestment with power rather than braking.
- Approach end engagements will result in aircraft damage to fuselage skin and horizontal tail.

WARNING & CAUTION LIGHT ANALYSIS (TYPICAL)

LIGHT	CONDITION	CORRECTIVE ACTION
 FIRE REAR (F)	ENGINE COMPARTMENT FIRE OR OVERHEAT CONDITION.	SEE FIRE WARNING PROCEDURES, THIS SECTION.
 MASTER CAUTION REAR (F)	ONE OR MORE LIGHTS ON CAUTION LIGHT PANEL ON.	CHECK CAUTION LIGHTS ON PANEL AND RESET MASTER CAUTION LIGHT.
	ARRESTING HOOK DOWN.	LAND PAST APPROACH-END BARRIER UNLESS APPROACH-END ENGAGEMENT IS INTENTIONAL.

CAUTION LIGHT PANEL

CAUTION LIGHT	CONDITION	CORRECTIVE ACTION
L GENERATOR	LEFT GENERATOR NOT OPERATING.	TURN ON OR RESET LEFT GENERATOR.
R GENERATOR	RIGHT GENERATOR NOT OPERATING.	TURN ON OR RESET RIGHT GENERATOR.
CANOPY	CANOPY UNLOCKED ((F) ONE OR BOTH).	LOCK CANOPY.
UTILITY HYD	UTILITY HYDRAULIC SYSTEM PRESSURE 1500 PSI OR LESS.	MONITOR SYSTEM PRESSURE.
FLIGHT HYD	FLIGHT HYDRAULIC SYSTEM PRESSURE 1500 PSI OR LESS.	
EXT TANKS EMPTY	EXTERNAL TANKS EMPTY.	ADVISORY.
IFF	MODE IV INCORRECTLY COMPARING CODED INTERROGATIONS.	SELECT ANOTHER MODE TO OBTAIN IFF IDENTIFICATION.
OXYGEN	OXYGEN REMAINING 0.5 LITER OR LESS, OR PRESSURE 40 PSI OR LESS.	DESCEND TO A SAFE ALTITUDE AND MONITOR SUPPLY PRESSURE.
ENGINE ANTI-ICE ON	ANTI-ICE SYSTEM OPERATING.	ADVISORY.
L FUEL LOW	USABLE FUEL REMAINING IN LEFT SYSTEM 400 LB OR LESS.	CHECK FUEL BALANCE.
R FUEL LOW	USABLE FUEL REMAINING IN RIGHT SYSTEM 400 LB OR LESS.	
L FUEL PRESS	LEFT SYSTEM FUEL PRESSURE 6.5 PSI OR LESS.	REDUCE RPM, DESCEND TO 25,000 FEET OR BELOW, AND MONITOR FUEL FLOW.
R FUEL PRESS	RIGHT SYSTEM FUEL PRESSURE 6.5 PSI OR LESS.	
AIR DATA COMPUTER	CADC MALFUNCTIONED, OUTPUTS UNRELIABLE.	SEE CADC/PITOT-STATIC MALFUNCTION, THIS SECTION.
DC OVERLOAD	DC SYSTEM OVERLOAD AND AT LEAST ONE TR FAILED.	REDUCE DC LOAD.

REAR (F)

FUEL SYSTEM INDICATOR LIGHTS

INDICATOR LIGHT	CONDITION
CENTERLINE ON	EXT FUEL CL TRANSFER SWITCH ON.
PYLONS ON	EXT FUEL PYLONS TRANSFER SWITCH ON.
TIPS ON	INOPERATIVE.
LEFT BOOST OFF	LEFT BOOST PUMP SWITCH OFF OR AUTOBALANCE SWITCH AT LEFT LOW.
CROSSFEED ON	CROSSFEED SWITCH ON OR AUTOBALANCE SWITCH AT LEFT OR RIGHT LOW.
RIGHT BOOST OFF	RIGHT BOOST PUMP SWITCH OFF OR AUTOBALANCE SWITCH AT RIGHT LOW.

F-51-106(1)C

Figure 3-10.

EMERGENCY ENTRANCE

NORMAL ENTRANCE (LEFT SIDE OF FUSELAGE)

1. PUSH TWO LATCHES TO OPEN DOOR.
2. PULL HANDLES OUT UNTIL ENGAGED.

Note

A MODERATE FORCE IS REQUIRED TO ROTATE HANDLES.

3. ROTATE HANDLES FULLY CLOCKWISE TO UNLOCK AND RAISE CANOPIES TO FULL OPEN.

CANOPY JETTISON ENTRANCE
(EITHER SIDE OF FUSELAGE)

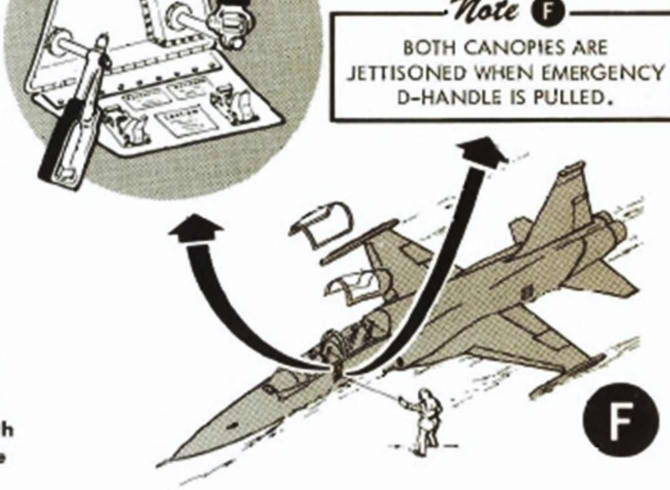
WARNING

Do not use this method when residual fuel is around cockpit area.

1. PUSH LATCH TO OPEN DOOR.
2. PULL D-HANDLE OUT TO FULL LENGTH (APPROXIMATELY 6 FEET).

Note (F)

BOTH CANOPIES ARE JETTISONED WHEN EMERGENCY D-HANDLE IS PULLED.



IF UNABLE TO OPEN CANOPY

1. BREAK CANOPY BEHIND CREWMEMBER WITH AX OR SIMILAR IMPLEMENT.

Note

SPRAYING CANOPY WITH CO_2 WILL CAUSE GLASS TO BECOME BRITTLE AND EASY TO BREAK.

AFTER ACCESS TO COCKPIT IS GAINED

WARNING

- **Inadvertent seat ejection is possible if handgrips are raised.**
- **(F) To avoid initiation of sequenced ejection system, cut catapult and drogue gun initiator hose on both seats before attempting to rescue crewmember(s).**

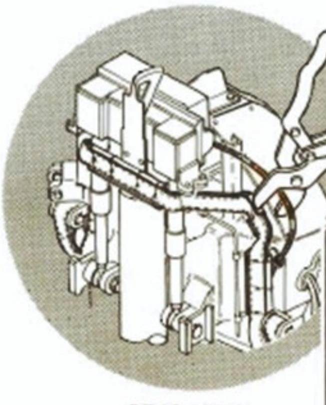
STANDARD SEAT

1. CUT CATAPULT HOSE, USING WISS BULLDOG SHEARS NO. 5 OR BOLT CUTTER.

F-5 1-82(1)D CATAPULT HOSE

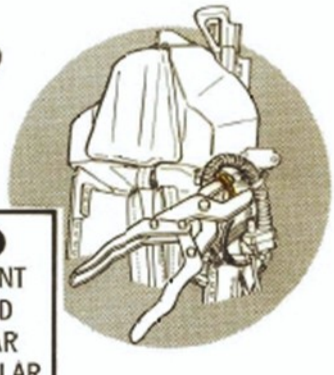
IMPROVED SEAT

1. CUT CATAPULT HOSE AT "CUT HERE" PLACARD, USING WISS BULLDOG SHEARS NO. 5 OR SHEAR-TYPE BOLT CUTTER.
2. CUT DROGUE GUN INITIATOR HOSE ON PILOT'S LEFT SIDE OF SEAT.



REAR VIEW

(F) FRONT AND REAR SIMILAR



FRONT VIEW

Figure 3-11.

SECTION IV

CREW DUTIES

F-5E 1-64

(This section does not apply.)

OPERATING LIMITATIONS

SECTION V

F-5 1-79(1)

TABLE OF CONTENTS

INSTRUMENT MARKINGS

Instrument markings are shown in figure 5-1. These markings are not necessarily repeated elsewhere in the text.

ENGINE LIMITATIONS

The engine transient and steady state operating envelope lies outside the aircraft 1.0 g flight envelope shown in Speed Profile Max Thrust chart in section VI except in the low-speed, high-altitude portion of the flight envelope between 30,000 feet altitude and the maximum altitude where the engine transient and the aircraft 1.0 g flight envelope coincide. Therefore, the engines are capable of steady-state operation with any aircraft maneuvers within the aircraft envelope for any atmosphere. The engines are also capable of any engine transient within the envelope with the aircraft in 1.0 g flight. However, there are combinations of severe aircraft maneuvers and engine nonafterburning to afterburning transients which can cause an engine to stall or flame out. Other engine operating limitations are shown in figure 5-2.

WARNING

Ⓔ [Before T.O. 1F-5E-592] Rapidly retarding the throttles to IDLE at load factors greater than +3.0 g may result in inadvertent engine shutdown.

NOTE

During maneuvering flight at high altitude and high angles of attack in heavy buffet, throttle movement from below MIL to MAX may result in engine compressor stall and/or flameout.

AUX INTAKE DOOR FAILURE DURING GROUND OPERATION

With the aux intake doors indicator showing barber pole or CLOSE during ground operations, engine operation is restricted to IDLE and MAX, to prevent overheating. Occasional transients are permissible for taxiing.

AIRCRAFT SYSTEMS AIRSPEED LIMITATIONS

Limiting airspeeds for operation of aircraft systems are shown in figure 5-3.

INSTRUMENT MARKINGS (TYPICAL)

EHU-31/A EHU-31A/A

Note
EGT MARKINGS BASED ON GRADE JP-4 FUEL.

EXHAUST GAS TEMPERATURE

- 140°C MINIMUM
- 325°C TO 650°C CONTINUOUS OPERATION
- 685°C MAXIMUM
- 925°C MAXIMUM DURING START AND ACCELERATION
- 675°C TO 685°C ALLOWABLE UNDER LIMITED CONDITIONS

HYDRAULIC PRESSURE

- 1500 PSI MINIMUM
- 2800 TO 3200 PSI NORMAL RANGE
- 3200 PSI MAXIMUM

OIL PRESSURE

- 5 PSI MINIMUM
- 20 TO 55 PSI NORMAL OPERATING RANGE
- 55 TO 100 PSI

ACCELEROMETER

- -3.0 G'S MINIMUM
- +7.33 G'S MAXIMUM

ENGINE TACHOMETER

- 49% RPM IDLE MINIMUM
- 80% TO 103% RPM CONTINUOUS
- 107% RPM MAXIMUM DURING ENGINE TRANSIENT (SEE RPM NOTE 3 ON FIGURE 5-2.)

AIRSPEED-MACH INDICATOR

- MAXIMUM ALLOWABLE LANDING GEAR EXTENSION AIRSPEED 260 KIAS
- ▲ MAXIMUM ALLOWABLE INDICATED AIR-SPEED WHICH IS EQUIVALENT TO 710 KEAS

F-5 1-48(1)A

Figure 5-1.

ENGINE OPERATING LIMITATIONS

CONDITION (STEADY-STATE)	❸ RPM%	EGT — °C	NOZZLE POSITION %	OIL PRESS PSI	DURATION MINUTES
GROUND START	10 (MIN)	❶	———	INDICATION	———
IDLE	49-52	———	70-80	5-20	———
MAX CONTINUOUS	90-103	650	———	20-55	NO LIMIT
MIL	❹ 90-103	❷ 665-675	0-16	20-55	30
MAX	❹ 90-103	❷ 665-675	50-80	20-55	15
FLUCTUATION LIMITS (ALL POWER SETTINGS)	±1	±7.5	±3(RANDOM) ±2(CYCLING)	±2	———

Note

TAKEOFF SHOULD NOT BE ATTEMPTED UNLESS ENGINE RPM FALLS WITHIN THE FOLLOWING LIMITS:

OAT °C	% RPM
0 AND HIGHER	101 ± 2
-26 TO 0	98 ± 3
-42 TO -26	95 ± 3
-43 AND BELOW	92 +3/-2

OTHER LIMITATIONS

EGT:

❶ 845°C — ABORT START. IF 925°C IS EXCEEDED, DO NOT RESTART UNTIL ENGINE HOT SECTION HAS BEEN INSPECTED FOR DAMAGE.

❷ DURING AIRCRAFT MANEUVERS INVOLVING RAPID RAM AIR TEMPERATURE CHANGES SUCH AS ENCOUNTERED DURING CLIMBS, DIVES, ACCELERATIONS, ETC, EGT MAY INCREASE ABOVE 675°C. THIS IS ACCEPTABLE PROVIDING EGT RETURNS WITHIN STEADY-STATE LIMITS (665°TO 675°C) ONCE STABILIZED LEVEL FLIGHT IS ESTABLISHED. HOWEVER, EGT SHOULD NOT EXCEED 685°C DURING THESE MANEUVERS. AT LOW COMPRESSOR INLET AIR TEMPERATURE (BELOW -25°C), MIL AND MAX EGT WILL DROP BELOW 665°C.

3. AT LOW COMPRESSOR AIR INLET TEMPERATURES, MIL AND AB EGT WILL CUT BACK BELOW OPERATING LIMITS.

RPM:

1. RPM WILL VARY AS A FUNCTION OF COMPRESSOR INLET TEMPERATURE.
2. FLIGHT IDLE EQUAL TO OR HIGHER THAN GROUND STEADY STATE.

❸ DURING ENGINE TRANSIENTS — RPM MAY MOMENTARILY EXCEED STEADY-STATE VALUES (UP TO 107%), BUT SHALL NOT EXCEED 103% FOR MORE THAN 1 SECOND.

❹ RPM OF ENGINES SHALL BE WITHIN 2% OF EACH OTHER AT MIL OR AB POWER WHEN THE RPM ARE BETWEEN 99% AND 103% AND SHALL BE WITHIN 3% OF EACH OTHER WHEN THE RPM ARE LESS THAN 99% IN MIL OR AB POWER.

OIL PRESSURE:

1. DURING COLD WEATHER STARTS, PRESSURE MAY EXCEED 55 PSI. TO EXPEDITE OIL WARMUP, ENGINE MAY BE OPERATED AT MIL POWER. IF PRESSURE DOES NOT RETURN TO OPERATING LIMITS WITHIN 6 MINUTES AFTER ENGINE START, SHUT DOWN ENGINE.
2. IF A SUDDEN CHANGE OF 10 PSI OR GREATER PRESSURE INDICATION OCCURS AT ANY STABILIZED RPM, SHUT DOWN ENGINE IF SEIZURE INDICATED.

ENGINE TRANSIENTS:

1. FOLLOWING RAPID THROTTLE MOVEMENT, ENGINE INSTRUMENTS SHOULD STABILIZE WITHIN FLUCTUATION RANGE WITHIN 10 SECONDS.
2. ENGINES ON WHICH THE NOZZLE IS FULLY OPEN AT MAX POWER WILL SHOW A FUEL FLOW CUTBACK TO KEEP EGT WITHIN LIMITS. THESE ENGINES WILL TAKE APPROXIMATELY 5 SECONDS LONGER FOR EGT TO RETURN WITHIN LIMITS. TO PREVENT AB BLOWOUT WHILE RETARDING THROTTLE IN AFTERBURNER RANGE, MAINTAIN AN EGT OF 620°C OR HIGHER. IF EGT INDICATES BELOW 620°C, RETARD THROTTLE SLOWLY UNTIL NOZZLE MOVEMENT INDICATES A DECREASE (CLOSING), THEN RESUME THROTTLE MOVEMENT.

F-5 1-53(1)B

Figure 5-2.

AIRCRAFT SYSTEMS AIRSPEED LIMITATIONS

SYSTEM OR CONDITION	MAXIMUM AIRSPEED	REMARKS
Canopy Open, Ground Operation	50 KIAS	
Deploy Drag Chute	180 KIAS	Nosewheel must be on ground.
Flap System Cruise Maneuver Full	(whichever is less) 550 KIAS/0.95 mach 550 KIAS/0.95 mach 330 KIAS/0.85 mach	Maintain load factor between 0 g and 6.0 g during actuation of flaps.
Hook Arrestment Speed BAK-9 BAK-12 (Conventional) BAK-12 (Dual) Dual Mode Single Mode MA-1A (Modified)	 160 knots 160 knots DO NOT ENGAGE 144 knots 125 knots.	**NOTE** The arresting hook system is an emergency system. Limiting speeds do not mean that arrestment should be avoided at any speed when emergency arrestment is required.
Landing Gear Extended or Gear Doors Open	260 KIAS	
Landing Lights Failure To Retract	300 KIAS	
Ⓔ Lower Gun Bay Access Door [Before T.O. 1F-5E-585]	580 knots (below 10,000 feet in any configuration)	**WARNING** Airspeed above 580 KIAS may result in doors' opening and possible engine damage from FOD.
Nosewheel Steering Engaged	65 KIAS	

Figure 5-3.

PROHIBITED MANEUVERS

a. Intentional spins.
b. Ⓕ Exceeding 29 units AOA.
c. Exceeding 20 units AOA with centerline stores installed or with asymmetric pylon stores, regardless of flap position.
d. The following are structural limits and require AFTO Form 781 entry, if inadvertently exceeded.
   (1) Continuous 360-degree rolls with more than half aileron (halfway to spring stop).
   (2) Exceeding negative 2.0 g with speed brake extended.
   (3) Exceeding aileron spring stop except for spin recovery and emergencies.
   (4) Entering 360-degree full deflection (to spring stop) abrupt aileron rolls at load factors greater than 5.0 g without pylon stores or 1.0 g with pylon stores.
   (5) Abrupt full deflection rudder reversals with empty 275-gallon centerline tank.
   (6) Abrupt full deflection rudder reversals at airspeeds in excess of 400 KIAS with a 150-gallon centerline tank (empty or with any fuel).
   (7) Abrupt aileron or rudder inputs with 275-gallon fuel tanks on inboard wing stations.

OTHER OPERATING LIMITATIONS

ENGINE OIL SYSTEM LIMITATIONS

Due to engine oil supply and pressure requirements, engine operation is restricted to the following:

Zero Oil Pressure—60 seconds

CAUTION

Maintain a close check of oil pressure during maneuvering flight, particularly when negative-g or rolling maneuvers are performed. During these conditions of flight, oil venting will occur. Excessive loss of oil may be indicated by oil pressure fluctuations.

FUEL SYSTEM LIMITATIONS

Negative-g operating limitations are shown in figure 5-4. Operation is not recommended in the shaded areas on figure 5-4 due to possible fuel starvation. In addition to the above, the following also apply:

a. Dive angles in excess of normal descents with high power settings can result in flameouts when the fuel quantity in either system is below 650 pounds.
b. Engine operation with fuel boost pumps inoperative at altitudes above 25,000 feet or fuel flow above 9800 pph can result in engine flameout.
c. Crossfeeding should be discontinued when fuel quantity in either internal system is 650 pounds or less.
d. Sustained zero-g flight at high engine power settings can cause engine fuel starvation.
e. Negative-g flight should be avoided with less than 650 pounds of fuel in either system; or during crossfeed; or during gravity feed fuel system operation.

ALTERNATE FUEL LIMITATIONS

JET A-1 w/FSII or JP-8 (when JP-4 is primary fuel):

a. RPM may be affected but should remain within normal limits.
b. Ground start and airstart of engines may be more difficult, especially during cold weather.
c. Airstart and afterburner relight envelope will be degraded. Use JET A-1 w/FSII or JP-8 airstart envelope.

FUEL SYSTEM NEGATIVE-G LIMITATION

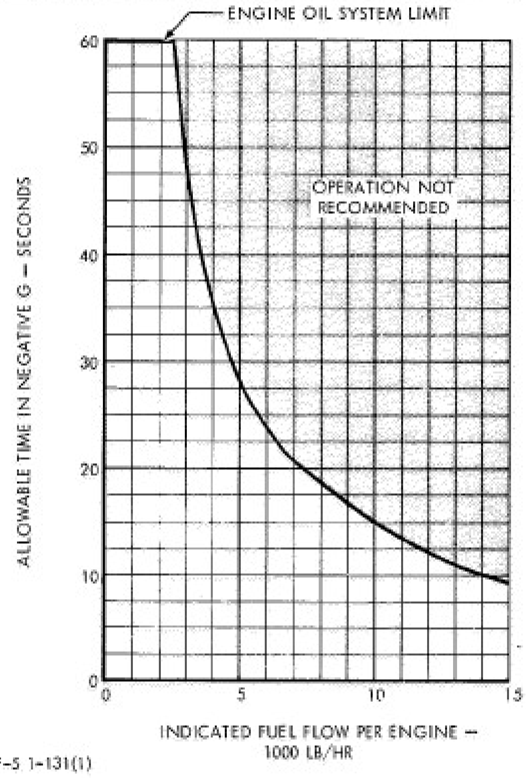


Figure 5-4.

JP-4 (when JET A-1 w/FSII or JP-8 is primary fuel):

a. RPM may be affected but should remain within normal limits.
b. Airstart and afterburner relight envelope will be degraded. Use JET A-1 w/FSII or JP-8 airstart envelope.

EMERGENCY FUEL LIMITATIONS

JP-5: Flight limited to one flight only. Avoid operation when OAT is –51°F (–46°C) or colder.

JET A-1 w/o FSII: Flight limited to one flight only (maximum of 1 hour), below 20,000 feet altitude. Fuel boost pump inlet or fuel control icing is not necessarily associated with other icing conditions but will occur whenever free water exists in the fuel and the temperature of the fuel falls below +32°F (0°C).

STABILITY AUGMENTER LIMITATIONS

Engaging stability augmenter system in flight should not be attempted at:

a. Airspeeds above 400 KIAS
b. Altitudes below 5000 feet AGL.
c. Load factor other than 1.0 g.

NOTE

Disengage the stability augmenter system immediately upon suspicion of malfunction.

AIR-CONDITIONING SYSTEM LIMITATIONS

The air-conditioning system should not be operated in the manual position unless the automatic mode fails. Operation in the manual mode can cause freezing of the water separator or overheating of the aft electrical bay. The resulting load on the bearings from freezing of the water separator will significantly reduce the life of the air-conditioning unit.

WHEEL BRAKES

Excessive accumulation of brake heat and insufficient cooling time can cause wheel assembly fuse plug blowout, resulting in tire deflation on subsequent takeoff or brake failure if the subsequent takeoff is aborted. Observe the following time limitations when wheel brakes are used.

COOLING TIME REQUIRED AFTER HEAVY BRAKING (With or Without Drag Chute)

AIRCRAFT WEIGHT—LB	DRAG CHUTE USED	REQUIRED COOLING TIME
Below 18,000 Below 15,000	Yes No	None
18,000 to 22,000 15,000 to 18,000	Yes No	30 Minutes
Above 22,000 Above 18,000	Yes No	60 Minutes (fuse plugs may actuate)

NOTE

- Limits requiring no cooling time do not provide for more than two consecutive full stop operations.
- Drag chute assumed deployed at 180 KIAS.

No time limit is required for touch-and-go landings if wheel brakes are not used during landing ground roll.

LANDING GEAR

Landing should be made with as low a sink rate as possible. Maximum landing sink rate for aircraft with less than 3700 pounds internal fuel, no stores, pylons and wingtip missiles optional is 600 fpm for normal landings and 400 fpm for crosswind landings. Maximum landing sink rate for all other configurations is 360 fpm for normal landings and 300 fpm for crosswind landings.

TIRE LIMIT SPEED

The maximum tire limit speed is 230 knots groundspeed. See appendix for tire limit speeds for various runway temperatures and pressure altitudes.

ASYMMETRIC CONFIGURATIONS

Single asymmetry is with one store under one wing and none under other wing or two stores under one wing and one store under the other wing. Double asymmetry is with two stores under one wing and none under the other wing. Intentional delivery of wing stores resulting in double asymmetry is not recommended. Maximum airspeed for double asymmetry is 450 KIAS or 0.85 mach, whichever is less. During flight, if any asymmetric configuration occurs, minimum recommended airspeed to retain at least one-half the available aileron deflection for maneuvering with gear and flaps up is:

200 KIAS for single asymmetry.

230 KIAS for single asymmetry involving partia or full 275-gallon tank.

280 KIAS for double asymmetry.

CAUTION

With asymmetric store configurations, rolling maneuvers entered at other than 1.0 G should not be performed with abrupt aileron inputs nor with maximum (spring stop) aileron deflection.

For landing with gear and flaps down, add the following to computed final approach speed:

10 KIAS for single asymmetry.

20 KIAS for single asymmetry involving partial or full 275-gallon tank.

45 KIAS for double asymmetry.

55 KIAS for double asymmetry involving partial or full 275-gallon tank.

CAUTION

Asymmetric conditions at heavy gross weights can require landing speeds in excess of the tire limit speeds. If possible, jettison asymmetric stores and/or reduce gross weight prior to landing.

NOTE

A full or partially full tank with an empty tank under the opposite wing is considered an asymmetric condition.

AIRCRAFT CONFIGURATION LIMITATIONS

Aircraft configuration limitations affecting takeoff and in-flight operations are contained in the Authorized Configurations For Takeoff chart and the In-Flight Carriage and Sequencing Limitations charts. The Authorized Configurations For Takeoff chart must be entered first to determine if a desired store configuration is authorized, and if any additional store loading restrictions for the configuration are necessary to maintain proper cg position for takeoff. The In-Flight Carriage and Sequencing Limitations charts are then entered to determine the aircraft in-flight limitations applicable to the store configuration, and for subsequent limitation changes when configurations change from use of and/or expenditure of stores. Employment/Release/Jettison charts are reference for data pertaining to operating limits for individual stores.

AUTHORIZED CONFIGURATIONS FOR TAKEOFF

The approved stores (weapons/and fuel tanks) and the stations on which various combinations of these stores may be loaded for takeoff are shown in figure 5-5 (Ⓔ sheets 1 and 2 for [T.O. 1F-5E-594] and [Before T.O. 1F-5E-594]; respectively) (Ⓕ sheets 3 and 4 for one and two crewmembers; respectively). Figure 5-5, sheet 5, provides numbered notes and other configuration limitations and legends applicable to the references on figure 5-5, sheets 1 thru 4. Each dot marker in the chart indicates an authorized outboard and inboard station configuration with approved wingtip and centerline station configurations shown in their respective columns. Numbered dot markers indicate that additional requirements are necessary to maintain the cg position forward of the aft cg limit during takeoff. Blank squares in matrix are unauthorized configurations.

IN-FLIGHT CARRIAGE AND SEQUENCING LIMITATIONS

Symmetrical and roll entry acceleration limits, maximum airspeeds, and the required sequence in the expenditure of munitions or use of fuel necessary to maintain satisfactory aircraft longitudinal stability and control characteristics are provided in figure 5-6, sheets 1 thru 20. Configurations are illustrated at the top of each chart from a maximum of five pylon stores, and progressively decreasing the number of stores carried until the last chart shows no pylon stores carried and wingtip launcher rails with or without missiles. Each configuration has individual configuration limits shown at the top of each chart, which may be modified and/or require additional other limitations for particular stores listed in the station columns. The modifying limitations are listed in the Sequencing and Other Limitations column and are more restrictive than those listed in the Configurations Limits. Shaded areas within the station columns represent any authorized station configuration but does not in itself require any sequencing and/or other limitation. As stores are expended, revised limitations can be determined by entering the next appropriate chart configuration illustrated. If a station loading for takeoff required three or less stores, proceed directly into the chart representative of the configuration and progressively proceed from that chart.

CAUTION

For wing stores, both like pylon stations must be identically configured before revising a particular configuration limitation.

EMPLOYMENT/RELEASE/JETTISON LIMITS

The airspeed, acceleration and dive angle limits, and the maneuvering flap and speed brake position required for safe employment of weapons from launchers and dispensers, and the release/jettison of stores from the pylons are shown in figure 5-7, sheets 1 and 2. Release/jettison airspeed limits listed in the chart are for individual stores and assure safe separation from the aircraft. However, some stores may require a lower limit due to influence characteristics caused by carriage of mixed store configurations. Therefore, the modifying limits that appear in the In-Flight Carriage and Sequencing Limitations charts referencing a release limit for a particular store shall take precedence over the release airspeed limit shown in the Employment/Release/Jettison Limits charts.

USE OF CHARTS

The following sample problem demonstrates use of the Authorized Configurations For Takeoff, In-Flight Carriage and Sequencing Limitations, and Employment/Release/Jettison Charts.

Sample Problem

Assume a combat mission requirement for an F-5E [T.O. 1F-5E-594] to carry 4 MK-82LD bombs on the wing pylons, a centerline pylon 275-gallon fuel tank, wingtip AIM-9J missiles, and full 20mm ammunition.

1. Enter the Authorized Configuration for Takeoff (figure 5-5, sheet 1) TIP column representing AIM-9B, E, J, J-1 missiles or TIP LAUNCHER RAILS. Simultaneously, proceed down the OUTBD column to MK-82LD.
2. From this point proceed right and intersect the MK-82LD column within the matrix portion of the chart labeled INBD. Note that the configuration is authorized; however, it displays a numbered ③ dot marker. In the ADDITIONAL BALLAST REQUIREMENTS block at the bottom of the chart the restriction for this symbol means: "FULL AMMO AND 200 LB OR HEAVIER CL STORE."
3. Since the CL column authorizes that a Tank (275 GAL) is permissible within the matrix for the configuration, the configuration is authorized.
4. Enter the In-Flight Carriage and Sequencing Limitations charts (figure 5-6, sheets 1 thru 20) in order of appearance of the aircraft configuration as represented by the silhouettes in each chart of the series. The silhouette on sheet 1 represents the loaded configuration (see LEGEND at top of chart for symbology).
5. In the Configuration Limits block, note the acceleration limits (load factors) for any internal fuel load are: "MAX SPEED 520 KIAS or 0.85 IMN (whichever is less); "SYM (G) +6.5, -2.0; ROLL ENTRY (G) +5.2, -1.0."
6. Enter the station section to determine if the loaded configuration is listed within the TIP, OUTBD, INBD, and CL columns.
   a. The shaded areas (no listing) in any of the columns represent any authorized store on the station as the aircraft is configured in the silhouette. (Without a listed store in the column, there is no additional limitation for the particular store.)
   b. It is recommended that the CL column listings be entered first to determine if there are sequencing and other limitations which modify those indicated in step 5, above.
7. The CL column lists the 275-Gallon Tank which establishes that in the OTHER LIMITATIONS column there is an additional limitation of "W/ANY FUEL: SYM (G) +4.0, -1.5; ROLL ENTRY (G) +3.2, -1.0." "EMPTY: SYM (G) +6.0, -2.0; ROLL ENTRY (G) +4.8, -1.0."
8. The INBD and OUTBD columns list the MK-82LD which establishes that in the OTHER LIMITATIONS column there is an additional limitation on MAX GUNFIRE-SEC. (TOTAL) for dot ① marker—5 seconds.
9. After the centerline fuel is expended, the empty tank is retained.
10. Inboard MK-82LD bombs are released on target. Release limits (figure 5-7, sheet 1) are: "AIRSPEED MIN 150 KIAS, MAX 550 KIAS or 0.90 IMN (whichever is less), +1.5 G to +0.5 G, DIVE ANGLE 0 degrees to 60 degrees, MANEUVER FLAPS and SPEED BRAKE—OPTIONAL."

NOTE

For single release of stores, retain limitations of the previous symmetrical configuration until the opposite store is released.

11. Proceed to the next configuration symbol (figure 5-6, sheets 10) representing wingtip missiles, 2 MK-82LD bombs on outboard pylons, and 275-gallon centerline pylon tank.
    a. Configuration Limits: MAX SPEED 600 KIAS OR 1.2 IMN (whichever is less)." "0.85 IMN or BELOW: SYM (G) +6.5, -2.0; ROLL ENTRY (G) +5.2, -1.0, ABOVE 0.85 IMN: SYM (G) +5.0, -2.0; ROLL ENTRY (G) +4.0, -1.0."
    b. 275-GAL TANK is listed in the CL column; an additional limitation exists for this configuration as follows: "EMPTY: SYM (G) +6.0, -2.0; ROLL ENTRY (G) +4.8, -1.0." .
    c. MK—82LD is listed in the OUTBD column; therefore, another additional limitation exists for this configuration, as follows: "DO NOT EXCEED 560 KIAS." This airspeed limitation modifies the Configuration Limits MAX SPEED of 600 KIAS. Note that there is no gunfire limit shown for ① dot marker, therefore the guns may be fired as desired. However, for ② dot marker there is a 5 second gunfire limit.
12. Outboard MK-82LD bombs are released on target. Release limits (figure 5-7, sheet 1) are: "AIRSPEED MIN 150 KIAS. MAX 550 KIAS OR 0.90 IMN (whichever is less), + 1.5 G to +0.5 G, DIVE ANGLE 0 degrees to 60 degrees, MANEUVER FLAPS and SPEED BRAKE—OPTIONAL."
13. Proceed to the next configuration symbol (figure 5-6, sheet 19) representing wingtip missiles and 275-gallon centerline pylon tank.
    a. Configuration Limits: MAX SPEED 650 KIAS OR 1.4 IMN (whichever is less); "SYM (G) +6.5, -2.0; ROLL ENTRY (G) +5.2, -1.0."
    b. TANK (275) EMPTY is listed in the CL column; an additional limitation exists for this configuration, as follows: "SYM (G) +6.0, -2.0; ROLL ENTRY (G) +4.8, -1.5."
14. The empty tank can be jettisoned. Refer to the Employment/Release/Jettison Limits Chart (figure 5-7, sheet 1) for tank jettison limits as follows: "AIRSPEED MIN 150 KIAS, MAX 450 KIAS or 0.95 IMN (whichever is less), +1.0 G LEVEL FLIGHT, MANEUVER FLAPS—UP, SPEED BRAKE—IN.
15. Proceed to the next configuration symbol (figure 5-6, sheet 20) representing wingtip missiles without pylon stores.
    a. Configuration Limits: MAX SPEED 710 KEAS OR 2.0 IMN (whichever is less); "SYM (G) +7.33, -3.0; ROLL ENTRY (G) +5.8, -1.0 . "W/INTERNAL FUEL MORE THAN 2200 LB—Ⓔ 0.95 TO 2.0 IMN, Ⓕ 0.92 TO 2.0 IMN—SYM (G) +6.5, -3.0 ROLL ENTRY (G) +5.2, -1.0.

CENTER-OF-GRAVITY LIMITATIONS

Stores must be expended in the recommended sequence to keep the cg within limits. T.O. 1-1B-40 should be consulted before flight in order to be fully aware of cg travel vs gross weight and to determine the consequences of expending stores in other than the recommended sequence.

BALLAST REQUIREMENTS Ⓔ

As an interim measure, until aircraft are modified by installation of fixed ballast, it is necessary to establish a temporary ballast condition to maintain adequate static stability margin by using ammunition loading.

BALLAST [Before T.O. 1F-5E-594]

Aircraft not modified by T.O. 1F-5E-594 are subject to the following temporary ballast restrictions.

WARNING

To preclude the possibility of exceeding aft cg limitations with or without stores, all aircraft not modified by T.O. 1F-5E-594 shall maintain a minimum of 100 rounds of live or dummy 20mm ammunition, or a full load of 20mm links; or equivalent ballast.

Carriage of a full load of ammunition will not be subject to this restriction, since the weight of the retained links will provide sufficient margin even after firing out.

BALLAST [T.O. 1F-5E-594]

Basic (fixed) ballast, dependent upon the individual aircraft configurations, (refer to T.O. 1-1B-40 for each aircraft), is installed in the nose section of aircraft modified by T.O. 1F-5E-594. In addition to the fixed ballast, approximately 80 pounds of variable ballast must be installed when inboard pylon fuel tanks are carried. The nose section can accommodate an approximate total of 240 pounds of fixed, variable, and future growth ballast; however, each individual aircraft's T.O. 1-1B-40 should be consulted to obtain the exact amount of ballast lead weight installed.

NOTE

Compliance with T.O. 1F-5E-594 will remove the foregoing required temporary ballast restrictions.

DART TARGET SYSTEM LIMITATIONS

TARGET FLIGHT CONDITION	AIRSPEED	ACCELER-ATION
STOWED (CRUISE & CLIMB)	310 KIAS (MAX)	0 to +1.5 G
LAUNCH	190 to 220 KIAS	+1.0 G
IN-TOW	Below 325 KIAS 325 to 350 KIAS 350 to 450 KIAS or 0.85 IMN (MAX) (whichever is less)	0 to +3.0 G 0 to +4.0 G 0 to +5.0 G

NOTE

Ⓔ With 150-gallon fuel tank on right pylon, do not fire guns until tank is empty and do not fire wingtip missiles until tank is released.

Ⓕ With 150-gallon fuel tank on right pylon, do not fire missiles until tank is released.

AUTHORIZED CONFIGURATIONS FOR TAKEOFF

E

[T.O. 1F-5E-594]

TIP — OUTBD — INBD — CL — INBD — OUTBD — TIP

TIP	OUTBD \ INBD	NO PYLON	PYLON	TANK (150 GAL)	TANK (275 GAL) ❶	MK-82 LD	MK-82 SE	MK-36	MK129E2	CBU-24B/B	CBU-49B/B	CBU-52B/B	CBU-58/B	CBU-71/B	BLU-1/B, B/B, C/B ❷ (U)	BLU-1/B, B/B, C/B ❷ (F)	BLU-27/B ❷ (U)	BLU-27/B ❷ (F)	BLU-27A/B, B/B, C/B ❷ (U)	BLU-27A/B, B/B, C/B ❷ (F)	BLU-32A/B, B/B, C/B (U)	BLU-32A/B, B/B, C/B (F)	LAU-3/A, A/A, B/A	LAU-60/A	LAU-68A/A, B/A	GBU-12/B, A/B (HS)	CENTERLINE (CL)
LCHR RAILS, AIM-9	NO PYLON	●	①	②	②	③	③	③	③	③	③	③	③	③	④	④	④	④	④	④	③	③	③	③	③		(ANY OF THE FOLLOWING) NO PYLON PYLON TANK (150 GAL) TANK (275 GAL) MK-82 LD MK-82 SE MK-84 LD MK-36 MK129E2 CBU-24B/B CBU-49B/B CBU-52B/B CBU-58/B, -71/B BLU-1/B, B/B, C/B (U) & (F) BLU-27/B (U) & (F) BLU-27A/B, B/B, C/B (U) & (F) BLU-32A/B, B/B, C/B (U) & (F) SUU-20/A (M) SUU-20A/A, B/A
LCHR RAILS, AIM-9	PYLON	①	①	②	②	③	③	③	③	③	③	③	③	③	④	④	④	④	④	④	③	③	③	③	③		
LCHR RAILS, AIM-9	MK-82 LD	①	①	③	③	③																					
LCHR RAILS, AIM-9	MK-82 SE	①	②	③	③		③																				
LCHR RAILS, AIM-9	MK-36	①	②	③	③			③																			
LCHR RAILS, AIM-9	MK129E2	①	①						③																		
LCHR RAILS, AIM-9	CBU-24B/B	①	①							③																	
LCHR RAILS, AIM-9	CBU-49B/B	①	①								③																
LCHR RAILS, AIM-9	CBU-52B/B	①	①									③															
LCHR RAILS, AIM-9	CBU-58/B	①	①										③														
LCHR RAILS, AIM-9	CBU-71/B	①	①											③													
LCHR RAILS, AIM-9	BLU-1/B, B/B, C/B (U)	②	②												④												
LCHR RAILS, AIM-9	BLU-1/B, B/B, C/B (F)	①	②													④											
LCHR RAILS, AIM-9	BLU-27/B (U)	②	②	⑤	⑤												④										
LCHR RAILS, AIM-9	BLU-27/B (F)	①	②	⑤	⑤													④									
LCHR RAILS, AIM-9	BLU-27A/B, B/B, C/B (U)	②	②	⑤	⑤														④								
LCHR RAILS, AIM-9	BLU-27A/B, B/B, C/B (F)	①	②	⑤	⑤															④							
LCHR RAILS, AIM-9	BLU-32A/B, B/B, C/B (U)	①	①																		③						
LCHR RAILS, AIM-9	BLU-32A/B, B/B, C/B (F)	①	②																			③					
LCHR RAILS, AIM-9	LAU-3/A, A/A, B/A	②	②	⑤	⑤																		③				
LCHR RAILS, AIM-9	LAU-60/A	②	②	⑤	⑤																			③			
LCHR RAILS, AIM-9	LAU-68A/A, B/A	②	②																						③		
LCHR RAILS, AIM-9	SUU-25A/A, C/A, E/A	②	②																								
LCHR RAILS, AIM-9	NO PYLON	●	①	②	②																						BRU-27A (MER): EMPTY
LCHR RAILS, AIM-9	PYLON	●	①	②	②																						BRU-27A (MER): EMPTY
LCHR RAILS, AIM-9	MK-82 LD	①	①	②	②																						BRU-27A (MER): EMPTY
LCHR RAILS, AIM-9	MK-82 SE	①	①	②	②																						BRU-27A (MER): EMPTY
LCHR RAILS, AIM-9	NO PYLON	①	①	②	②																						BRU-27A (MER): 2 TO 5 MK-82
LCHR RAILS, AIM-9	PYLON	①	①	②	②																						BRU-27A (MER): 2 TO 5 MK-82
LCHR RAILS, AIM-9	MK-82 LD	②	②																								BRU-27A (MER): 2 TO 5 MK-82 LD
LCHR RAILS, AIM-9	MK-82 SE	②	②																								BRU-27A (MER): 2 TO 5 MK-82 SE
LCHR RAILS, AIM-9	MK-82 LD	②	②	②	②																						BRU-27A (MER): 5 MK-82 LD
LCHR RAILS, AIM-9	MK-82 SE	②	②	②	②																						BRU-27A (MER): 5 MK-82 SE
LCHR RAILS, AIM-9	NO PYLON	●	①	②	②																					②	NO PYLON PYLON TANK (150 GAL) TANK (275 GAL)
LCHR RAILS, AIM-9	PYLON	①	①	②	②																					②	
LCHR RAILS, AIM-9	GBU-12/B, A/B (HS)	①	①	②	②																					②	
LCHR RAILS, AIM-9	GBU-12A/B (LS)	①	①	②	②																						
LCHR RAILS	TDU-10/B ❸	②																									RMU-10/A TOW REEL
AIM-9	TDU-10/B ❹			②																							RMU-10/A TOW REEL
TDU-11/B ❺ AIM-9	NO PYLON	●																									NO PYLON PYLON TANK (275 GAL)
AIM-9 (CAPTIVE ❻ OR LIVE)	NO PYLON	●																									NO PYLON PYLON TANK (275 GAL)

ADDITIONAL BALLAST REQUIREMENTS

- ● NONE.
- ① AMMO LINKS (560) OR EQUIVALENT BALLAST.
- ② FULL AMMO (560 ROUNDS).
- ③ FULL AMMO AND 200 LB OR HEAVIER CL STORE.
- ④ FULL AMMO AND 800 LB OR HEAVIER CL STORE.
- ⑤ FULL AMMO AND 1100 LB OR HEAVIER CL STORE.

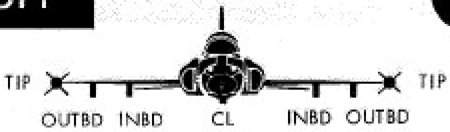
F-5 1-109(5)B

Figure 5-5 (Sheet 1).

AUTHORIZED CONFIGURATIONS FOR TAKEOFF

E

[BEFORE T.O. 1F-5E-594]



TIP	OUTBD \ INBD	NO PYLON	PYLON	TANK (150 GAL)	TANK (275 GAL) ❶	MK-82 LD	MK-82 SE	MK-36	M129E2	CBU-24 B/B	CBU-49 B/B	CBU-52 B/B	CBU-58/B	CBU-71/B	BLU-32A/B, B/B, C/B (U)	BLU-32A/B, B/B, C/B (F)	LAU-3/A, A/A, B/A	LAU-60/A	LAU-68A/A, B/A	GBU-12/B, A/B (HS)	CENTERLINE (CL)
LCHR RAILS, AIM-9	NO PYLON	●	①	①	①	②	②	②	②	②	②	②	②	②	②	②	②	②	②		(ANY OF THE FOLLOWING) NO PYLON, PYLON, TANK (150 GAL), TANK (275 GAL), MK-82 LD, MK-82 SE, MK-84 LD, MK-36, M129E2, CBU-24B/B, CBU-49B/B, CBU-52B/B, CBU-58/B, -71/B, BLU-1/B, B/B, C/B (U) & (F), BLU-27/B (U) & (F), BLU-27A/B, B/B, C/B (U) & (F), BLU-32A/B, B/B, C/B (U) & (F), SUU-20/A (M), SUU-20A/A, B/A
	PYLON	●	①	①	①	②	②	②	②	②	②	②	②	②	②	②	②	②	②		
	MK-82 LD	①	①		②	②															
	MK-82 SE	①	①				②														
	MK-36	①	①					②													
	M129E2	①	①						②												
	CBU-24 B/B	①	①							②											
	CBU-49 B/B	①	①								②										
	CBU-52 B/B	①	①									②									
	CBU-58/B	①	①										②								
	CBU-71/B	①	①											②							
	BLU-1/B, B/B, C/B (U)	①	①																		
	BLU-1/B, B/B, C/B (F)	①	①																		
	BLU-27/B (U)	①	①																		
	BLU-27/B (F)	①	①																		
	BLU-27A/B, B/B, C/B (U)	①	①																		
	BLU-27A/B, B/B, C/B (F)	①	①																		
	BLU-32A/B, B/B, C/B (U)	①	①												②						
	BLU-32A/B, B/B, C/B (F)	①	①													②					
	LAU-3/A, A/A, B/A	①	①														②				
	LAU-60/A	①	①															②			
	LAU-68A/A, B/A	①	①																②		
	SUU-25A/A, C/A, E/A	①	①																		
	NO PYLON	●	①	①	①																BRU-27/A (MER): EMPTY OR 2 TO 5 MK-82
	PYLON	●	①	①	①																
	MK-82 LD	①	①	①	①																BRU-27/A (MER): EMPTY OR 5 MK-82 LD
	MK-82 SE	①	①	①	①																BRU-27/A (MER): EMPTY OR 5 MK-82 SE
	NO PYLON	●	①	①	①															②	NO PYLON, PYLON, TANK (150 GAL), TANK (275 GAL)
	PYLON	●	①	①	①															②	
	GBU-12/B, A/B (HS)	①	①																	②	
	GBU-12A/B (LS)	①	①																		
LCHR RAILS	TDU-10/B ❸	①																			RMU-10/A TOW REEL
AIM-9	TDU-10/B ❹			①																	
TDU-11/B ❺ AIM-9	NO PYLON	●																			NO PYLON, PYLON, TANK (275 GAL)
AIM-9 (CAPTIVE OR LIVE) ❻	NO PYLON	●																			

ADDITIONAL BALLAST REQUIREMENTS

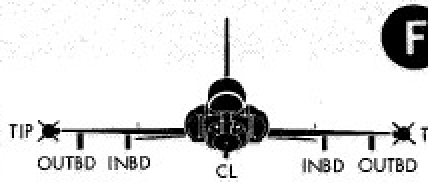
● NONE.
① FULL AMMO (560 ROUNDS).
② FULL AMMO AND 200 LB OR HEAVIER CL STORE.

F-5 1-109(1)G

Figure 5-5 (Sheet 2).

AUTHORIZED CONFIGURATIONS FOR TAKEOFF

F



ONE CREWMEMBER

WARNING

VARIABLE EXTERNAL TAIL BALLAST SHALL BE REMOVED FOR ALL FLIGHTS WITH WING PYLONS, WITH OR WITHOUT STORES.

TIP	OUTBD \ INBD	NO PYLON	PYLON	TANK (150 GAL)	TANK (275 GAL) ❶	MK-82 LD	MK-82 SE	MK-36	M129E2	CBU-24 B/B	CBU-49B/B	CBU-52B/B	CBU-58/B	CBU-71/B	BLU-32A/B, B/B, C/B (U)	BLU-32A/B, B/B, C/B (F)	LAU-3/A, A/A, B/A	LAU-60/A	LAU-68A/A, B/A	GBU-12/B, A/B (HS)	CENTERLINE (CL)
LCHR RAILS, AIM-9	NO PYLON	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		(ANY OF THE FOLLOWING) NO PYLON PYLON TANK (150 GAL) TANK (275 GAL) MK-82 LD MK-82 SE MK-84 LD MK-36 M129E2 CBU-24B/B CBU-49B/B CBU-52B/B CBU-58/B, -71/B BLU-1/B, B/B, C/B (U) & (F) BLU-27/B (U) & (F) BLU-27A/B, B/B, C/B (U) & (F) BLU-32A/B, B/B, C/B (U) & (F) SUU-20/A(M) ❼ SUU-20A/A, B/A ❼
	PYLON	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	①	①	●		
	MK-82 LD	●	●	①	①	●															
	MK-82 SE	●	●	①	①		●														
	MK-36	●	●	①	①			①													
	M129E2	●	●						●												
	CBU-24B/B	●	●							①											
	CBU-49B/B	●	●								①										
	CBU-52B/B	●	●									①									
	CBU-58/B	●	●										①								
	CBU-71/B	●	●											①							
	BLU-1/B, B/B, C/B (U)	●	●																		
	BLU-1/B, B/B, C/B (F)	●	●																		
	BLU-27/B (U)	●	●	④	④																
	BLU-27/B (F)	●	●	④	④																
	BLU-27A/B, B/B, C/B (U)	●	●	④	④																
	BLU-27A/B, B/B, C/B (F)	●	●	④	④																
	BLU-32A/B, B/B, C/B (U)	●	●												①						
	BLU-32A/B, B/B, C/B (F)	●	●													●					
	LAU-3/A, A/A, B/A	●	●	②	②												●				
	LAU-60/A	●	●	②	②													●			
	LAU-68A/A, B/A	●	●																●		
	SUU-25A/A, C/A, E/A	●	●																		
	NO PYLON	●	●	●	●																BRU-27/A (MER): EMPTY TO 5 MK-82
	PYLON	●	●	●	●																BRU-27/A (MER): EMPTY TO 5 MK-82
	MK-82 LD	●	●	●	●																BRU-27/A (MER): 5 MK-82 LD
	MK-82 SE	●	●	●	●																BRU-27/A (MER): 5 MK-82 SE
	MK-82 LD	●	●	①	●																BRU-27/A (MER): EMPTY
	MK-82 SE	●	●	①	①																BRU-27/A (MER): EMPTY
	NO PYLON	●	●	●	●															●	NO PYLON PYLON TANK (150 GAL) TANK (275 GAL)
	PYLON	●	●	●	●															●	
	GBU-12/B, A/B (HS)	●	●	③	③															●	
	GBU-12A/B (LS)	●	●	③	③																
LCHR RAILS	TDU-10/B ❸	●																			RMU-10/A TOW REEL
AIM-9	TDU-10/B ❹			●																	RMU-10/A TOW REEL
TDU-11/B ❺ AIM-9	NO PYLON	●																			NO PYLON PYLON TANK (275 GAL)
AIM-9 (CAPTIVE ❻ OR LIVE)	NO PYLON	●																			

ADDITIONAL BALLAST REQUIREMENTS

- ● NONE.
- ① FULL AMMO (140 ROUNDS).
- ② FULL AMMO AND 600 LB OR HEAVIER CL STORE.
- ③ FULL AMMO AND 1100 LB OR HEAVIER CL STORE.
- ④ FULL AMMO AND 1800 LB OR HEAVIER CL STORE.

F-5 1-109(2)E

Figure 5-5 (Sheet 3).

AUTHORIZED CONFIGURATIONS FOR TAKEOFF

F

TWO CREWMEMBERS

> **WARNING**
>
> VARIABLE EXTERNAL TAIL BALLAST SHALL BE REMOVED FOR ALL FLIGHTS WITH WING PYLON STORES.

TIP ⇩	OUTBD ⇩ / INBD ⇨	NO PYLON	PYLON	TANK (150 GAL)	TANK (275 GAL) ❶	MK-82 LD	MK-82 SE	MK-36	M129E2	CBU-24 B/B	CBU-49 B/B	CBU-52 B/B	CBU-58/B	CBU-71/B	BLU-32A/B, B/B, C/B (U)	BLU-32A/B, B/B, C/B (F)	LAU-3/A, A/A, B/A	LAU-60/A	LAU-68A/A, B/A	GBU-12/B, A/B (HS)	CENTERLINE (CL) ⇩
LCHR RAILS, AIM-9	NO PYLON	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		(ANY OF THE FOLLOWING)
	PYLON	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		
	MK-82 LD	●	●	●	①	●															NO PYLON PYLON TANK (150 GAL) TANK (275 GAL) MK-82 LD MK-82 SE MK-84 LD MK-36 M129E2 CBU-24B/B CBU-49B/B CBU-52B/B CBU-58/B, -71/B BLU-1/B, B/B, C/B (U) & (F) BLU-27/B (U) & (F) BLU-27A/B, B/B, C/B (U) & (F) BLU-32A/B, B/B, C/B (U) & (F) SUU-20/A(M) ❼ SUU-20A/A, B/A ❼
	MK-82 SE	●	●	①	①		●														
	MK-36	●	●	①	①			●													
	M129E2	●	●						●												
	CBU-24 B/B	●	●							●											
	CBU-49 B/B	●	●								●										
	CBU-52 B/B	●	●									●									
	CBU-58/B	●	●										●								
	CBU-71/B	●	●											●							
	BLU-1/B, B/B, C/B (U)	●	●																		
	BLU-1/B, B/B, C/B (F)	●	●																		
	BLU-27/B (U)	●	●	②	②																
	BLU-27/B (F)	●	●	②	②																
	BLU-27A/B, B/B, C/B (U)	●	●	②	②																
	BLU-27A/B, B/B, C/B (F)	●	●	②	②																
	BLU-32A/B, B/B, C/B (U)	●	●												●						
	BLU-32A/B, B/B, C/B (F)	●	●													●					
	LAU-3/A, A/A, B/A	●	●	①	①												●				
	LAU-60/A	●	●	①	①													●			
	LAU-68A/A, B/A	●	●																●		
	SUU-25A/A, C/A, E/A	●	●																		
	NO PYLON	●	●	●	●																BRU-27/A (MER): EMPTY TO 5 MK-82
	PYLON	●	●	●	●																
	MK-82 LD	●	●	●	●																BRU-27/A (MER): 5 MK-82 LD
	MK-82 SE	●	●	●	●																BRU-27/A (MER): 5 MK-82 SE
	MK-82 LD	●	●	●	●																BRU-27/A (MER): EMPTY
	MK-82 SE	●	●	●	●																
	NO PYLON	●	●	●	●															●	NO PYLON PYLON TANK (150 GAL) TANK (275 GAL)
	PYLON	●	●	●	●															●	
	GBU-12/B, A/B (HS)	●	●	①	①															●	
	GBU-12A/B (LS)	●	●	①	①																
LCHR RAILS	TDU-10/B ❸	●																			RMU-10/A TOW REEL
AIM-9	TDU-10/B ❹			●																	
TDU-11/B ❺ AIM-9	NO PYLON	●																			NO PYLON PYLON TANK (275 GAL)
AIM-9 (CAPTIVE ❻ OR LIVE)	NO PYLON	●																			

ADDITIONAL BALLAST REQUIREMENTS

● NONE.
① FULL AMMO (140 ROUNDS).
② FULL AMMO AND 1100 LB OR HEAVIER CL STORE.

F-5 1-111(1)E

Figure 5-5 (Sheet 4).

AUTHORIZED CONFIGURATIONS FOR TAKEOFF

Notes

1. AIM-9 REQUIRED ON TIP LCHR RAILS.
2. AIM-9 REQUIRED ON TIP LCHR RAILS WHEN CL 275-GAL TANK WITH FUEL OR MK-84 IS CARRIED.
3. LEFT OUTBD PYLON ONLY; OTHER WING STATIONS — NO PYLON.
4. LEFT OUTBD PYLON ONLY; TANK (150 GAL) ON RIGHT INBD PYLON ONLY; OTHER WING STATIONS — NO PYLON.
5. TDU-11/B ON LEFT TIP LCHR RAIL; AIM-9 ON RIGHT TIP LCHR RAIL.
6. MAY BE LOADED ON EITHER TIP LCHR RAIL WITH OPPOSITE TIP LCHR RAIL EMPTY.
7. ADAPTER REQUIRED.

OTHER CONFIGURATION LIMITATIONS:

1. AIM-9B, E, J, & J-1 MISSILES (CAPTIVE OR LIVE)	— SHALL HAVE WING AND ROLLERON ASSEMBLIES INSTALLED.
2. STORES ON WING PYLONS	— STORES SHALL BE IDENTICAL IN MODEL DESIGNATION, EXCEPT AS INDICATED IN NOTE 5 (EXAMPLE: LAU-3/A CANNOT BE MIXED WITH LAU-3A/A). WITH INBD PYLON FUEL TANKS, OUTBD PYLON WEAPONS MUST BE IDENTICAL.

MAXIMUM AUTHORIZED LOADS FOR ACCESSORIES:

LAU-3/A, A/A, B/A, -60/A	— (19) FFAR (MK4 MOTOR WITH INERT, MK1, MK5, M151, M156, OR WDU-4 WARHEAD)
LAU-68A/A, B/A	— (7) FFAR (MK4/40 MOTOR WITH INERT, MK1, MK5, M151, M156, OR WDU-4 WARHEAD)
SUU-25A/A, C/A, E/A	— (8) MK-24, LUU-1/B, 2/B OR 5/B FLARES
SUU-20 SERIES	— (6) BDU-33/MK-106 BOMBS & (4) FFAR (MK4/40 MOTOR WITH INERT, MK1, MK5, M151, OR M156 WARHEAD)
BRU-27/A MER	— (5) MK-82 LD OR MK-82 SE BOMBS (NOT MIXED)

THE FOLLOWING LEGEND AND ABBREVIATIONS APPLY TO THE AUTHORIZED CONFIGURATIONS FOR TAKEOFF AND IN-FLIGHT CARRIAGE & SEQUENCING LIMITATIONS CHARTS.

LEGEND

AIM-9	— AIM-9B, E, J, JOR J-1
BLU	— BLU-1, BLU-27, BLU-32 SERIES (U) OR (F)
BLU-1	— BLU-1 SERIES (U) OR (F)
BLU-27	— BLU-27 SERIES (U) OR (F)
BLU-32	— BLU-32 SERIES (U) OR (F)
CBU	— CBU-24, -49, -52, -58, -71 SERIES
GBU-12 (HS)	— GBU-12/B, A/B (LGB HIGH SPEED)
GBU-12 (LS)	— GBU-12A/B (LGB LOW SPEED)
LAU	— LAU-3, -60, -68 SERIES
M129	— M129E2
MER	— BRU-27/A
MK-82	— MK-82 LD OR MK-82 SE
SUU-20	— SUU-20 SERIES
SUU-25	— SUU-25 SERIES

ABBREVIATIONS

FFAR	— FOLDING FIN AIRCRAFT ROCKET
HS	— HIGH SPEED
LCHR	— LAUNCHER
LD	— LOW DRAG
LS	— LOW SPEED
MER	— MULTIPLE EJECTOR RACK

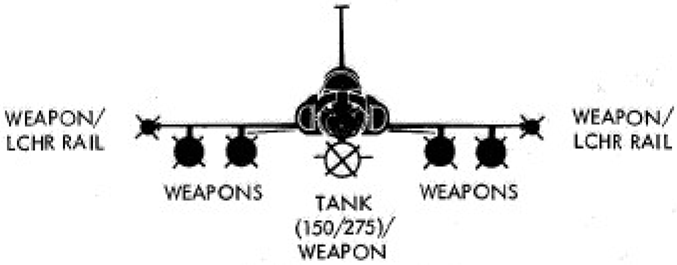
F-5 1-110(1)G

Figure 5-5 (Sheet 5).

IN-FLIGHT CARRIAGE & SEQUENCING LIMITATIONS

* CONFIGURATION LIMITS	
MAX SPEED:	520 KIAS OR 0.85 IMN (WHICHEVER IS LESS).
ACCELERATION LIMITS:	
SYM (G):	+6.5, -2.0
ROLL ENTRY (G):	+5.2, -1.0

* MODIFY ABOVE LIMITS FOR THE SPECIFIC STORE-STATION CONFIGURATIONS LISTED BELOW.



5 PYLON STORES

Note

- FOR WEAPON DELIVERY DATA, REFER TO T.O. 1F-5E-34-1-1.
- RETAINING EMPTY ACCESSORY (BOMB RACK, DISPENSERS, ROCKET LAUNCHERS OR RAILS) DOES NOT CHANGE STATION CONFIGURATIONS.
- LAUNCH: INDICATES FIRING MISSILES FROM LAUNCHER RAILS.
- RELEASE: INDICATES DROPPING STORES FROM PYLONS, INCLUDING ROCKET LAUNCHERS ON RAILS AND FLARE DISPENSERS.
- STORES ON 4 WING PYLONS: RECOMMEND RELEASE OF INBD STORES FIRST BECAUSE LIMITATIONS ON OUTBD STORES ARE LESS RESTRICTIVE THAN INBD STORES.
- STORES ON 2 WING PYLONS: LIMITATIONS LESS RESTRICTIVE WITH STORES ON OUTBD PYLONS.

GUNFIRE RESTRICTIONS

MAX GUNFIRE — SEC (TOTAL) SUBCOLUMN HEADING NUMBERED DOT MARKERS APPLY AS FOLLOWS.

E	F
1 [T.O. 1F-5E-594]	1 ONE CREW
2 BEFORE [T.O. 1F-5E-594]	2 TWO CREW

TIP	OUTBD	INBD	CL	OTHER LIMITATIONS						
				SYM (G)	ROLL ENTRY (G)	MAX GUNFIRE-SEC. (TOTAL)				SEQUENCING
						E		F		
						1	2	1	2	
			MK-84 LD	+5.0 -2.0	+4.0 -1.0					
			TANK (275) W/ANY FUEL	+4.0 -1.5	+3.2 -1.0					
			TANK (275) EMPTY	+6.0 -2.0	+4.8 -1.0					
			TANK (150) W/WO FUEL							
	MK-82 LD	MK-82 LD				5	0			E RETAIN CL STORE.
	MK-82 SE	MK-82 SE				2	0			
	LAU	LAU								
	MK-36	MK-36				2	0	0		
	M129	M129		+5.0 -1.0	+4.0 0	2	0			
	BLU-27/B	BLU-27/B				0				

(CONTINUED ON NEXT PAGE)

F-5 1-113(1)F

Figure 5-6 (Sheet 1).

IN-FLIGHT CARRIAGE & SEQUENCING LIMITATIONS

* CONFIGURATION LIMITS	
MAX SPEED:	520 KIAS OR 0.85 IMN (WHICHEVER IS LESS).
ACCELERATION LIMITS:	
SYM (G):	+6.5, -2.0
ROLL ENTRY (G):	+5.2, -1.0

* MODIFY ABOVE LIMITS FOR THE SPECIFIC STORE-STATION CONFIGURATIONS LISTED BELOW.

5 PYLON STORES

(CONTINUED FROM PREVIOUS PAGE)

TIP	OUTBD	INBD	CL	OTHER LIMITATIONS: SYM (G)	ROLL ENTRY (G)	MAX GUNFIRE-SEC. (TOTAL) (E) (1)	(E) (2)	(F) (1)	(F) (2)	SEQUENCING	
	BLU-1 (U)	BLU-1 (U)				0				(E) TIP LCHR RAILS W/MK-84 LD OR TANK W/FUEL: DO NOT RELEASE OUTBD STORE BEFORE INBD.	(E) RETAIN CL STORE.
	BLU-1 (F)	BLU-1 (F)				2					
	BLU-27A/B, B/B, C/B (U)	BLU-27A/B, B/B, C/B (U)				0					
	BLU-27A/B, B/B, C/B (F)	BLU-27A/B, B/B, C/B (F)				2					
	BLU-32 (U)	BLU-32 (U)				2	0	0		TIP LCHR RAILS: DO NOT RELEASE OUTBD BLU-32 ABOVE 400 KIAS OR 0.80 IMN.	
	BLU-32 (F)	BLU-32 (F)				5	0				
	CBU	CBU				2	0	0		AIM-9B W/MK-84 LD OR TANK W/FUEL: DO NOT RELEASE INBD CBU ABOVE 400 KIAS OR 0.80 IMN. (E) RETAIN CL STORE.	
	GBU-12 (HS)	GBU-12 (HS)				5	2			TIP LCHR RAILS: DO NOT RELEASE OUTBD GBU ABOVE 500 KIAS OR 0.80 IMN. (E) [BEFORE T.O. 1F-5E-594] RETAIN CL STORE.	

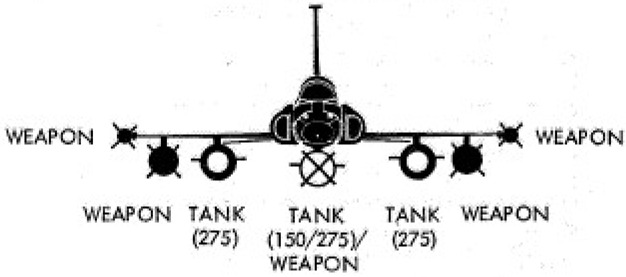
F-5 1-113(2)F

Figure 5-6 (Sheet 2).

IN-FLIGHT CARRIAGE & SEQUENCING LIMITATIONS

* CONFIGURATION LIMITS	INBD TANKS W/ANY FUEL	INBD TANKS EMPTY
MAX SPEED (WHICHEVER IS LESS):	500 KIAS OR 0.80 IMN	520 KIAS OR 0.85 IMN
ACCELERATION LIMITS:	SYM (G): +4.0, -1.5 ROLL ENTRY (G): +3.2, -1.0	SYM (G): +5.0, -1.5 ROLL ENTRY (G): +4.0, -1.0

* MODIFY ABOVE LIMITS FOR THE SPECIFIC STORE-STATION CONFIGURATIONS LISTED BELOW:



5 PYLON STORES

TIP	OUTBD	INBD	CL	SYM (G)	ROLL ENTRY (G)	MAX GUNFIRE-SEC. (TOTAL) E ❶	E ❷	F ❶	F ❷	SEQUENCING
ALL CONFIGURATIONS W/TANKS (275)										● DO NOT LAUNCH AIM-9's BEFORE RELEASING INBD TANKS. ● DO NOT RELEASE INBD TANKS W/FUEL BEFORE RELEASING OUTBD WEAPONS.
AIM-9			M129	+5.0 -1.0	+4.0 0					
AIM-9	MK-82	TANK (275) W/ANY FUEL	MER W/ BOMBS			0	0	❶		❶ F 1 CREW WITH MK-82 SE: EITHER DO NOT FIRE GUN OR DO NOT RELEASE BOMBS FROM MER.
AIM-9	MK-82	TANK (275) EMPTY	MER W/ BOMBS			2	0			
AIM-9	MK-82	TANK (275) W/ANY FUEL	MER EMPTY			2	0			
AIM-9	MK-82	TANK (275) EMPTY	MER EMPTY			2	2			
AIM-9	GBU-12 (HS OR LS)	TANK (275) W/ANY FUEL				0		0	0	F 1 CREW: RETAIN CL STORE.
AIM-9	GBU-12 (HS OR LS)	TANK (275) EMPTY				5				
AIM-9	MK-82	TANK (275) W/ANY FUEL				5	0	0	0	E RETAIN CL STORE.
AIM-9	MK-82	TANK (275) EMPTY				5	2			E RETAIN CL STORE.
AIM-9	MK-36	TANK (275) W/ANY FUEL				2	0	0	0	E RETAIN CL STORE.
AIM-9	MK-36	TANK (275) EMPTY				5	2			E RETAIN CL STORE.

(CONTINUED ON NEXT PAGE)

F-5 1-117(1)D

Figure 5-6 (Sheet 3).

IN-FLIGHT CARRIAGE & SEQUENCING LIMITATIONS

* CONFIGURATION LIMITS		
	INBD TANKS W/ANY FUEL	INBD TANKS EMPTY
MAX SPEED (WHICHEVER IS LESS):	500 KIAS OR 0.80 IMN	520 KIAS OR 0.85 IMN
ACCELERATION LIMITS:	SYM (G): +4.0, -1.5 ROLL ENTRY (G): +3.2, -1.0	SYM (G): +5.0, -1.5 ROLL ENTRY (G): +4.0, -1.0

* MODIFY ABOVE LIMITS FOR THE SPECIFIC STORE-STATION CONFIGURATIONS LISTED BELOW:

5 PYLON STORES

(CONTINUED FROM PREVIOUS PAGE)

TIP	OUTBD	INBD	CL	OTHER LIMITATIONS: SYM (G)	ROLL ENTRY (G)	MAX GUNFIRE-SEC. (TOTAL) (E) (1)	(E) (2)	(F) (1)	(F) (2)	SEQUENCING
ALL CONFIGURATIONS W/TANKS (275)										● DO NOT LAUNCH AIM-9's BEFORE RELEASING INBD TANKS. ● DO NOT RELEASE INBD TANKS/W FUEL BEFORE RELEASING OUTBD WEAPON.
AIM-9	LAU-3/60	TANK (275) W/ANY FUEL				2	0	0	0	(E) & (F) 1 CREW: RETAIN CL STORE.
AIM-9	LAU-3/60	TANK (275) EMPTY				5	2	0		(E) & (F) 1 CREW: RETAIN CL STORE.
AIM-9	BLU-27	TANK (275) W/ANY FUEL				0			0	RETAIN CL STORE.
AIM-9	BLU-27	TANK (275) EMPTY				2				RETAIN CL STORE.

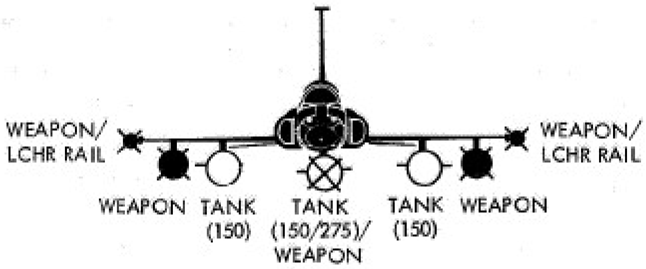
F-5 1-117(2)E

Figure 5-6 (Sheet 4).

IN-FLIGHT CARRIAGE & SEQUENCING LIMITATIONS

* CONFIGURATION LIMITS	
MAX SPEED:	520 KIAS OR 0.85 IMN (WHICHEVER IS LESS).
ACCELERATION LIMITS:	
SYM (G):	+6.0, -1.5
ROLL ENTRY (G):	+4.8, -1.0

* MODIFY ABOVE LIMITS FOR THE SPECIFIC STORE-STATION CONFIGURATIONS LISTED BELOW.



5 PYLON STORES

TIP	OUTBD	INBD	CL	SYM (G)	ROLL ENTRY (G)	MAX GUNFIRE-SEC. (TOTAL) (E) (1)	(E) (2)	(F) (1)	(F) (2)	SEQUENCING
			TANK (275) W/ANY FUEL	+4.0 -1.5	+3.2 -1.0					
			TANK (275) EMPTY	+6.0 -1.5	+4.8 0					
			MK-84 LD	+5.0 -1.5	+4.0 -1.0					
			M129	+5.0 -1.0	+4.0 0					
LCHR RAILS		TANK (150) W/ANY FUEL								DO NOT RELEASE OUTBD WEAPONS ABOVE 400 KIAS OR 0.80 IMN.
	GBU-12 (HS OR LS)	TANK (150) W/ANY FUEL				0		0	0	(F) 1 CREW: RETAIN CL STORE.
	GBU-12 (HS OR LS)	TANK (150) EMPTY				5				
	MK-82	TANK (150) W/ANY FUEL	MER W/ BOMBS	+5.0 -1.0	+4.0 0	0	0	(1)		(1) (F) 1 CREW: EITHER DO NOT FIRE GUN OR DO NOT RELEASE BOMBS FROM MER.
	MK-82	TANK (150) EMPTY	MER W/ BOMBS			2	0			
	MK-82	TANK (150) W/ANY FUEL	MER EMPTY			2	0			
	MK-82	TANK (150) EMPTY	MER EMPTY			2	2			
	MK-82 LD	TANK (150) W/ANY FUEL				2	0	0		(E) RETAIN CL STORE.
	MK-82 LD	TANK (150) EMPTY				5	2			

(CONTINUED ON NEXT PAGE)

F-5 1-118(1)E

Figure 5-6 (Sheet 5).

IN-FLIGHT CARRIAGE & SEQUENCING LIMITATIONS

* CONFIGURATION LIMITS	
MAX SPEED:	520 KIAS OR 0.85 IMN (WHICHEVER IS LESS).
ACCELERATION LIMITS:	
SYM (G):	+6.5, -2.0
ROLL ENTRY (G):	+5.2, -1.0

* MODIFY ABOVE LIMITS FOR THE SPECIFIC STORE-STATION CONFIGURATIONS LISTED BELOW.

5 PYLON STORES

(CONTINUED FROM PREVIOUS PAGE)

TIP	OUTBD	INBD	CL	OTHER LIMITATIONS: SYM (G)	ROLL ENTRY (G)	MAX GUNFIRE-SEC. (TOTAL) (E) (1)	(E) (2)	(F) (1)	(F) (2)	SEQUENCING
	MK-82 SE / MK-36	TANK (150) W/ANY FUEL				2	0	0	0	(E) RETAIN CL STORE.
	MK-82 SE / MK-36	TANK (150) EMPTY				5	2			
	LAU-3/60	TANK (150) W/ANY FUEL				2	0	0	0	(E) AND (F) 1 CREW: RETAIN CL STORE.
	LAU-3/60	TANK (150) EMPTY				5	2	0		
	BLU-27	TANK (150) W/ANY FUEL				0			0	RETAIN CL STORE.
	BLU-27	TANK (150) EMPTY				2				

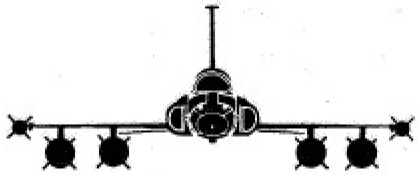
F-5 1-118(2)F

Figure 5-6 (Sheet 6).

IN-FLIGHT CARRIAGE & SEQUENCING LIMITATIONS

* CONFIGURATION LIMITS	
MAX SPEED:	520 KIAS OR 0.85 IMN (WHICHEVER IS LESS).
ACCELERATION LIMITS:	
SYM (G):	+6.5, -2.0
ROLL ENTRY (G):	+5.2, -1.0

* MODIFY ABOVE LIMITS FOR THE SPECIFIC STORE-STATION CONFIGURATIONS LISTED BELOW.



4 PYLON STORES

(CL – NO PYLON/PYLON)

TIP	OUTBD	INBD	CL	OTHER LIMITATIONS: SYM (G)	ROLL ENTRY (G)	MAX GUNFIRE-SEC. (TOTAL) E ❶	E ❷	F ❶	F ❷	SEQUENCING
	GBU-12 (HS)	GBU-12 (HS)				5				TIP LCHR RAILS: DO NOT RELEASE OUTBD GBU ABOVE 500 KIAS.
	M129	M129		+5.0 -1.0	+4.0 0					
	MK-36	MK-36						0		
	CBU	CBU								
	BLU-32 (U)	BLU-32 (U)						0		TIP LCHR RAILS: DO NOT RELEASE OUTBD BLU-32 ABOVE 400 KIAS OR 0.80 IMN.
	BLU-32 (F)	BLU-32 (F)								

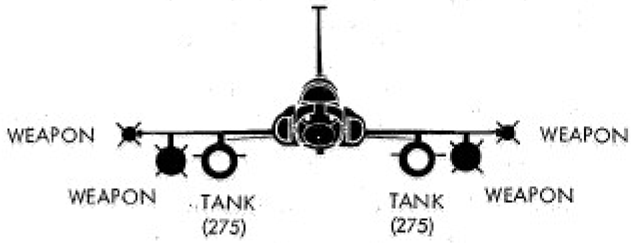
F-5 1-122(2)E

Figure 5-6 (Sheet 7).

IN-FLIGHT CARRIAGE & SEQUENCING LIMITATIONS

✱ CONFIGURATION LIMITS		
	INBD TANKS W/ANY FUEL	INBD TANKS EMPTY
MAX SPEED (WHICHEVER IS LESS):	500 KIAS OR 0.80 IMN	520 KIAS OR 0.85 IMN
ACCELERATION LIMITS:	SYM (G): +4.0, −1.5 ROLL ENTRY (G): +3.2, −1.0	SYM (G): +5.0, −1.5 ROLL ENTRY (G): +4.0, −1.0

✱ MODIFY ABOVE LIMITS FOR THE SPECIFIC STORE-STATION CONFIGURATIONS LISTED BELOW:



4 PYLON STORES

(CL – NO PYLON/PYLON)

TIP	OUTBD	INBD	CL	OTHER LIMITATIONS						
				SYM (G)	ROLL ENTRY (G)	MAX GUNFIRE-SEC. (TOTAL) (E) (1)	(E) (2)	(F) (1)	(F) (2)	SEQUENCING
ALL CONFIGURATIONS W/TANKS (275)										● DO NOT LAUNCH AIM-9's BEFORE RELEASING INBD TANKS. ● DO NOT RELEASE INBD TANKS/W FUEL BEFORE RELEASING OUTBD WEAPON.
AIM-9	GBU-12 (HS OR LS)	TANK (275) W/ANY FUEL				0			0	
AIM-9	GBU-12 (HS OR LS)	TANK (275) EMPTY				5				
AIM-9	MK-82 MK-36	TANK (275) W/ANY FUEL						0	0	
AIM-9	LAU-3/60	TANK (275) W/ANY FUEL							0	

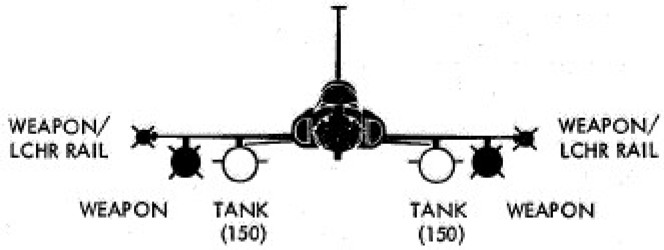
F-5 1-197(1)A

Figure 5-6 (Sheet 8).

IN-FLIGHT CARRIAGE & SEQUENCING LIMITATIONS

* CONFIGURATION LIMITS	
MAX SPEED:	520 KIAS OR 0.85 IMN (WHICHEVER IS LESS).
ACCELERATION LIMITS:	
SYM (G):	+6.0, -1.5
ROLL ENTRY (G):	+4.8, -1.0

* MODIFY ABOVE LIMITS FOR THE SPECIFIC STORE-STATION CONFIGURATIONS LISTED BELOW.



4 PYLON STORES

(CL — NO PYLON/PYLON)

TIP	OUTBD	INBD	CL	OTHER LIMITATIONS						
				SYM (G)	ROLL ENTRY (G)	MAX GUNFIRE-SEC. (TOTAL) E ❶	MAX GUNFIRE-SEC. (TOTAL) E ❷	MAX GUNFIRE-SEC. (TOTAL) F ❶	MAX GUNFIRE-SEC. (TOTAL) F ❷	SEQUENCING
LCHR RAILS		TANK (150) W/ANY FUEL								DO NOT RELEASE OUTBD WEAPONS ABOVE 400 KIAS OR 0.80 IMN.
	GBU-12 (HS OR LS)	TANK (150) W/ANY FUEL				0			0	
	GBU-12 (HS OR LS)	TANK (150) EMPTY				5				
	MK-82 LD	TANK (150) W/ANY FUEL						0		
	MK-82 SE / MK-36	TANK (150) W/ANY FUEL						0	0	
	LAU-3/60	TANK (150) W/ANY FUEL							0	

F-5 1-183(1)C

Figure 5-6 (Sheet 9).

IN-FLIGHT CARRIAGE & SEQUENCING LIMITATIONS

✱ CONFIGURATION LIMITS	
MAX SPEED:	600 KIAS OR 1.2 IMN (WHICHEVER IS LESS)
ACCELERATION LIMITS:	
0.85 IMN OR BELOW:	
SYM (G):	+6.5, -2.0
ROLL ENTRY (G):	+5.2, -1.0
ABOVE 0.85 IMN:	
SYM (G):	+5.0, -2.0
ROLL ENTRY (G):	+4.0, -1.0

✱ MODIFY ABOVE LIMITS FOR THE SPECIFIC STORE-STATION CONFIGURATIONS LISTED BELOW.

3 PYLON STORES

(INBD — NO PYLON/PYLON)

TIP	OUTBD	INBD	CL	OTHER LIMITATIONS: SYM (G)	ROLL ENTRY (G)	MAX GUNFIRE-SEC. (TOTAL) E ❶	E ❷	F ❶	F ❷	SEQUENCING
			TANK (275) W/ANY FUEL	+4.0 -1.5	+3.2 -1.0					
			TANK (275) EMPTY	❶ +6.0 -2.0	❶ +4.8 -1.0					❶ ACCEL LIMITS 0.85 IMN OR BELOW.
			TANK (150) W/WO FUEL							
			MK-84 LD	+5.0 -2.0	+4.0 -1.0					
			M129	+5.0 -1.0	+4.0 0					DO NOT EXCEED 0.90 IMN.
			BLU							
			CBU							DO NOT EXCEED 1.02 IMN.
	MK-82		MER W/ BOMBS	+5.0 -1.0	+4.0 0	5	5			DO NOT EXCEED 560 KIAS.
			MER EMPTY				5			
AIM-9B	CBU		MK-84 LD OR TANK (150/275) W/FUEL				5			DO NOT EXCEED 400 KIAS OR 0.85 IMN.
							5			DO NOT EXCEED 520 KIAS OR 0.85 IMN.
	MK-82 LD						5			DO NOT EXCEED 560 KIAS.
	MK-82 SE	PYLON				5	5			
	MK-36									
	MK-82 SE	NO PYLON					5			
	MK-36									

(CONTINUED ON NEXT PAGE)

F-5 1-114(1)E

Figure 5-6 (Sheet 10).

IN-FLIGHT CARRIAGE & SEQUENCING LIMITATIONS

* CONFIGURATION LIMITS	
MAX SPEED:	600 KIAS OR 1.2 IMN (WHICHEVER IS LESS)
ACCELERATION LIMITS:	
<u>0.85 IMN OR BELOW:</u>	
SYM (G):	+6.5, -2.0
ROLL ENTRY (G):	+5.2, -1.0
<u>ABOVE 0.85 IMN:</u>	
SYM (G):	+5.0, -2.0
ROLL ENTRY (G):	+4.0, -1.0

* MODIFY ABOVE LIMITS FOR THE SPECIFIC STORE-STATION CONFIGURATIONS LISTED BELOW.

3 PYLON STORES

(INBD – NO PYLON/PYLON)

(CONTINUED FROM PREVIOUS PAGE)

TIP	OUTBD	INBD	CL	OTHER LIMITATIONS						
				SYM (G)	ROLL ENTRY (G)	MAX GUNFIRE-SEC. (TOTAL) E		F		SEQUENCING
						1	2	1	2	
	GBU-12 (HS OR LS)						5			
	M129			+5.0 -1.0	+4.0 0		5			
	BLU-1 (F)									
	BLU-27 (F)	PYLON				5	5			
	BLU-32 (F)									
	BLU-1 (F)									
	BLU-27 (F)	NO PYLON					5			DO NOT EXCEED 520 KIAS OR 0.85 IMN.
	BLU-32 (F)									
	BLU-1 (U)					5	5			
	BLU-27 (U)									
	BLU-32 (U)						5			
	SUU-25					5	5			
	LAU									

F-5 1-114(2)E

Figure 5-6 (Sheet 11).

IN-FLIGHT CARRIAGE & SEQUENCING LIMITATIONS

* CONFIGURATION LIMITS	
MAX SPEED:	600 KIAS OR 1.2 IMN (WHICHEVER IS LESS)
ACCELERATION LIMITS:	
0.85 IMN OR BELOW:	
SYM (G):	+6.5, -2.0
ROLL ENTRY (G):	+5.2, -1.0
ABOVE 0.85 IMN:	
SYM (G):	+5.0, -2.0
ROLL ENTRY (G):	+4.0, -1.0

* MODIFY ABOVE LIMITS FOR THE SPECIFIC STORE-STATION CONFIGURATIONS LISTED BELOW.

3 PYLON STORES

(OUTBD — NO PYLON/PYLON)

TIP	OUTBD	INBD	CL	SYM (G)	ROLL ENTRY (G)	MAX GUNFIRE-SEC. (TOTAL) Ⓔ ❶	Ⓔ ❷	Ⓕ ❶	Ⓕ ❷	SEQUENCING	
			TANK (275) W/ANY FUEL	+4.0 -1.5	+3.2 -1.0						
			TANK (275) EMPTY	❶ +6.0 -2.0	❶ +4.8 -1.0					❶ ACCEL. LIMITS 0.85 IMN OR BELOW.	
			TANK (150) W/WO FUEL								
			MK-84 LD	+5.0 -2.0	+4.0 -1.0						
			M129	+5.0 -1.0	+4.0 0					DO NOT EXCEED 0.90 IMN.	
			BLU								
			CBU							DO NOT EXCEED 1.02 IMN.	
		MK-82				5	0			DO NOT EXCEED 560 KIAS.	Ⓔ RETAIN CL STORE.
		MK-36									
		M129		+5.0 -1.5	+4.0 0	5	0			DO NOT EXCEED 520 KIAS OR 0.85 IMN.	
		CBU				5	0				
		LAU-68				5	0				
	PYLON	LAU-3/60				2	0	0			
	NO PYLON	LAU-3/60				2	0				
AIM-9		GBU-12 (HS)				5	2			Ⓔ DO NOT LAUNCH AIM-9's ABOVE 500 KIAS OR 0.80 IMN.	Ⓔ [BEFORE T.O. 1F-5E-594] RETAIN CL STORE.
LCHR RAILS		GBU-12 (HS)				5	2			DO NOT EXCEED 500 KIAS OR 0.80 IMN.	

(CONTINUED ON NEXT PAGE)

F-5 1-116(1)D

Figure 5-6 (Sheet 12).

IN-FLIGHT CARRIAGE & SEQUENCING LIMITATIONS

* CONFIGURATION LIMITS	
MAX SPEED:	600 KIAS OR 1.2 IMN (WHICHEVER IS LESS)
ACCELERATION LIMITS:	
0.85 IMN OR BELOW:	
SYM (G):	+6.5, -2.0
ROLL ENTRY (G):	+5.2, -1.0
ABOVE 0.85 IMN:	
SYM (G):	+5.0, -2.0
ROLL ENTRY (G):	+4.0, -1.0

* MODIFY ABOVE LIMITS FOR THE SPECIFIC STORE-STATION CONFIGURATIONS LISTED BELOW.

3 PYLON STORES

(OUTBD – NO PYLON/PYLON)

(CONTINUED FROM PREVIOUS PAGE)

TIP	OUTBD	INBD	CL	OTHER LIMITATIONS: SYM (G)	ROLL ENTRY (G)	MAX GUNFIRE-SEC. (TOTAL) (E) 1	(E) 2	(F) 1	(F) 2	SEQUENCING
		BLU-27A/B, B/B, C/B BLU-1 (U) BLU-27/B (F)				2				RETAIN CL STORE. DO NOT EXCEED 520 KIAS OR 0.85 IMN.
	PYLON	BLU-1 (F)				2				AIM-9 W/MK-84 LD OR 275 GAL TANK W/ANY FUEL: DO NOT LAUNCH AIM-9'S.
	NO PYLON	BLU-1 (F)				5				
	PYLON	BLU-27/B (U)				0				
	NO PYLON	BLU-27/B (U)				2				
	PYLON	BLU-32 (U)				2	0			W/AIM-9: DO NOT EXCEED 520 KIAS OR 0.85 IMN AND DO NOT LAUNCH AIM-9'S ABOVE 400 KIAS OR 0.80 IMN. W/TIP LCHR RAILS: DO NOT EXCEED 400 KIAS OR 0.80 IMN. (E) RETAIN CL STORE.
	NO PYLON	BLU-32 (U)				5	0			
		BLU-32 (F)				5	0			

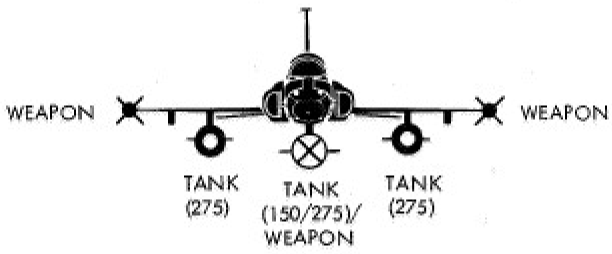
F-5 1-116(2)D

Figure 5-6 (Sheet 13).

IN-FLIGHT CARRIAGE & SEQUENCING LIMITATIONS

* CONFIGURATION LIMITS		
	INBD TANKS W/ANY FUEL	INBD TANKS EMPTY
MAX SPEED (WHICHEVER IS LESS):	500 KIAS OR 0.80 IMN	520 KIAS OR 0.85 IMN
ACCELERATION LIMITS:	SYM (G): +4.0, -1.5 ROLL ENTRY (G): +3.2, -1.0	SYM (G): +5.0, -1.5 ROLL ENTRY (G): +4.0, -1.0

* MODIFY ABOVE LIMITS FOR THE SPECIFIC STORE-STATION CONFIGURATIONS LISTED BELOW:



3 PYLON STORES

(OUTBD — NO PYLON/PYLON)

TIP	OUTBD	INBD	CL	OTHER LIMITATIONS: SYM (G)	ROLL ENTRY (G)	MAX GUNFIRE-SEC. (TOTAL) E (1)	E (2)	F (1)	F (2)	SEQUENCING
AIM-9	ALL CONFIGURATIONS W/TANKS (275) →									DO NOT LAUNCH AIM-9'S BEFORE RELEASING INBD TANKS.
AIM-9			EXCEPT MER M129	+5.0 -1.0	+4.0 0		2			
AIM-9		TANK (275) W/ANY FUEL	MER W/ BOMBS			2	0			
AIM-9		TANK (275) EMPTY	MER W/ BOMBS			2	2			
AIM-9		TANK (275) W/ANY FUEL	MER EMPTY			5	2			
AIM-9		TANK (275) EMPTY	MER EMPTY				2			

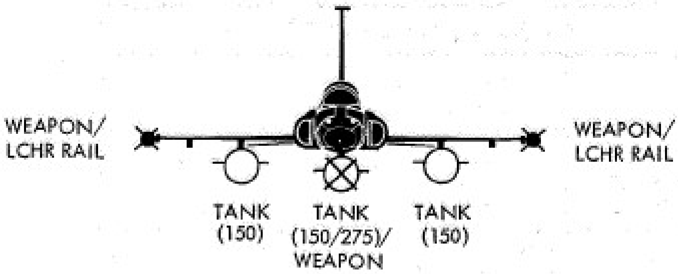
F-5 1-119(1)E

Figure 5-6 (Sheet 14).

IN-FLIGHT CARRIAGE & SEQUENCING LIMITATIONS

* CONFIGURATION LIMITS	
MAX SPEED:	560 KIAS OR 1.2 IMN (WHICHEVER IS LESS)
ACCELERATION LIMITS: 0.85 IMN OR BELOW:	
SYM (G):	+6.0, -1.5
ROLL ENTRY (G):	+4.8, -1.0
ABOVE 0.85 IMN:	
SYM (G):	+5.0, -1.5
ROLL ENTRY (G):	+4.0, -1.0

* MODIFY ABOVE LIMITS FOR THE SPECIFIC STORE-STATION CONFIGURATIONS LISTED BELOW.



3 PYLON STORES

(OUTBD – NO PYLON/PYLON)

TIP	OUTBD	INBD	CL	OTHER LIMITATIONS: SYM (G)	ROLL ENTRY (G)	MAX GUNFIRE-SEC. (TOTAL) E 1	E 2	F 1	F 2	SEQUENCING
			TANK (275) W/ANY FUEL	+4.0 -1.5	+3.2 -1.0					
			MK-84 LD	+5.0 -1.5	+4.0 -1.0					
			M129	+5.0 -1.0	+4.0 0					DO NOT EXCEED 0.90 IMN.
			BLU							
			CBU							DO NOT EXCEED 1.02 IMN.
		TANK (150) W/WO FUEL	EXCEPT MER				2			
LCHR RAILS		TANK (150) W/ANY FUEL					2			DO NOT EXCEED 400 KIAS OR 0.80 IMN.
		TANK (150) EMPTY					2			DO NOT EXCEED 520 KIAS OR 0.85 IMN.
		TANK (150) W/ANY FUEL	MER W/ BOMBS	+5.0 -1.0	+4.0 0	2	0			
		TANK (150) EMPTY				2	2			
		TANK (150) W/ANY FUEL	MER EMPTY			5	2			
		TANK (150) EMPTY					2			

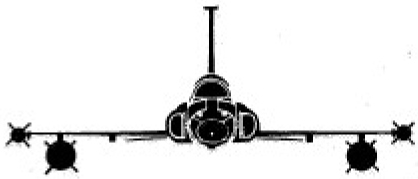
F-5 1-120(1)F

Figure 5-6 (Sheet 15).

IN-FLIGHT CARRIAGE & SEQUENCING LIMITATIONS

* CONFIGURATION LIMITS	
MAX SPEED:	600 KIAS OR 1.2 IMN (WHICHEVER IS LESS)
ACCELERATION LIMITS: 0.85 IMN OR BELOW:	
SYM (G):	+6.5, -2.0
ROLL ENTRY (G):	+5.2, -1.0
ABOVE 0.85 IMN:	
SYM (G):	+5.0, -2.0
ROLL ENTRY (G):	+4.0, -1.0

* MODIFY ABOVE LIMITS FOR THE SPECIFIC STORE-STATION CONFIGURATIONS LISTED BELOW.



2 PYLON STORES

(CL & INBD — NO PYLON/PYLON)

TIP	OUTBD	INBD	CL	OTHER LIMITATIONS: SYM (G)	ROLL ENTRY (G)	MAX GUNFIRE-SEC. (TOTAL) E ❶	E ❷	F ❶	F ❷	SEQUENCING
	MK-82 LD						5			DO NOT EXCEED 560 KIAS.
	MK-82 SE	PYLON				5	5			
	MK-36	PYLON				5	5			
	MK-82 SE	NO PYLON					5			
	MK-36	NO PYLON					5			
	GBU (HS OR LS)						5			
	M129			+5.0 -1.0	+4.0 0		5			DO NOT EXCEED 520 KIAS OR 0.85 IMN.
	CBU						5			
	LAU					5	5			
	SUU-25					5	5			
	BLU-1 (U)					5	5			
	BLU-27 (U)					5	5			
	BLU-1 (F)	PYLON				5	5			
	BLU-27 (F)	PYLON				5	5			
	BLU-32 (F)	PYLON				5	5			
	BLU-1 (F)	NO PYLON					5			
	BLU-27 (F)	NO PYLON					5			
	BLU-32 (F)	NO PYLON					5			
	BLU-32 (U)						5			

F-5 1-180(1)C

Figure 5-6 (Sheet 16).

IN-FLIGHT CARRIAGE & SEQUENCING LIMITATIONS

* CONFIGURATION LIMITS	
MAX SPEED:	600 KIAS OR 1.2 IMN (WHICHEVER IS LESS)
ACCELERATION LIMITS:	
0.85 IMN OR BELOW:	
SYM (G):	+6.5, -2.0
ROLL ENTRY (G):	+5.2, -1.0
ABOVE 0.85 IMN:	
SYM (G):	+5.0, -2.0
ROLL ENTRY (G):	+4.0, -1.0

* MODIFY ABOVE LIMITS FOR THE SPECIFIC STORE-STATION CONFIGURATIONS LISTED BELOW.

2 PYLON STORES

(CL & OUTBD — NO PYLON/PYLON)

TIP	OUTBD	INBD	CL	OTHER LIMITATIONS: SYM (G)	ROLL ENTRY (G)	MAX GUNFIRE-SEC. (TOTAL) E 1	E 2	F 1	F 2	SEQUENCING
AIM-9		GBU-12 (HS)				5				E DO NOT LAUNCH AIM-9's ABOVE 500 KIAS OR 0.80 IMN.
LCHR RAILS		GBU-12 (HS)				5				DO NOT EXCEED 500 KIAS OR 0.80 IMN.
AIM-9		BLU-32								DO NOT EXCEED 520 KIAS OR 0.85 IMN. DO NOT LAUNCH AIM-9's ABOVE 400 KIAS OR 0.80 IMN.
LCHR RAILS		BLU-32								DO NOT EXCEED 400 KIAS OR 0.80 IMN.
		MK-82								DO NOT EXCEED 560 KIAS.
		MK-36								
		M129		+5.0 -1.0	+4.0 0					DO NOT EXCEED 520 KIAS OR 0.85 IMN.
		CBU								
		LAU-68								
	PYLON	LAU-3/60						0		
	NO PYLON	LAU-3/60								

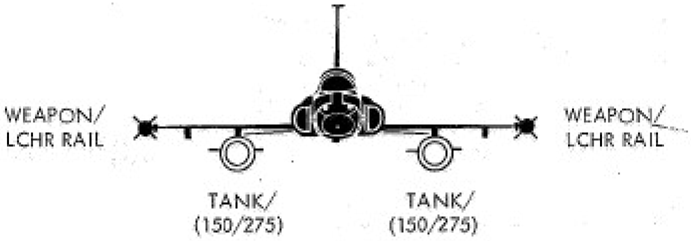
F-5 1-186(1)C

Figure 5-6 (Sheet 17).

IN-FLIGHT CARRIAGE & SEQUENCING LIMITATIONS

* CONFIGURATION LIMITS	
MAX SPEED:	560 KIAS OR 1.2 IMN (WHICHEVER IS LESS)
ACCELERATION LIMITS:	
<u>0.85 IMN OR BELOW:</u>	
SYM (G):	+6.0, -1.5
ROLL ENTRY (G):	+4.8, -1.0
<u>ABOVE 0.85 IMN:</u>	
SYM (G):	+5.0, -1.5
ROLL ENTRY (G):	+4.0, -1.0

* MODIFY ABOVE LIMITS FOR THE SPECIFIC STORE-STATION CONFIGURATIONS LISTED BELOW.



2 PYLON STORES

(CL & OUTBD — NO PYLON/PYLON)

TIP	OUTBD	INBD	CL	OTHER LIMITATIONS: SYM (G)	ROLL ENTRY (G)	MAX GUNFIRE-SEC. (TOTAL) E 1	E 2	F 1	F 2	SEQUENCING	
AIM-9		TANK (275) W/ANY FUEL		+4.0 -1.5	+3.2 -1.0		2			DO NOT EXCEED 500 KIAS OR 0.80 IMN.	DO NOT LAUNCH AIM-9'S BEFORE RELEASING INBD TANKS.
		TANK (275) EMPTY		+5.0 -1.5	+4.0 -1.0		2			DO NOT EXCEED 520 KIAS OR 0.85 IMN.	
		TANK (150) W/WO FUEL					2				
LCHR RAILS		TANK (150) W/ANY FUEL					2			DO NOT EXCEED 400 KIAS OR 0.80 IMN.	
		TANK (150) EMPTY					2			DO NOT EXCEED 520 KIAS OR 0.85 IMN.	

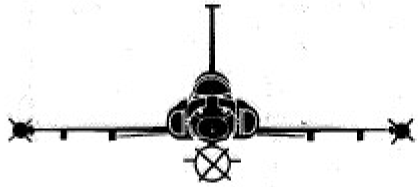
F-5 1-181(1)D

Figure 5-6 (Sheet 18).

IN-FLIGHT CARRIAGE & SEQUENCING LIMITATIONS

* CONFIGURATION LIMITS	
MAX SPEED:	650 KIAS OR 1.4 IMN (WHICHEVER IS LESS).
ACCELERATION LIMITS:	
SYM (G):	+6.5, -2.0
ROLL ENTRY (G):	+5.2, -1.0

* MODIFY ABOVE LIMITS FOR THE SPECIFIC STORE-STATION CONFIGURATIONS LISTED BELOW.



1 CL STORE

(OUTBD & INBD — NO PYLON/PYLON)

TIP	OUTBD	INBD	CL	OTHER LIMITATIONS: SYM (G)	ROLL ENTRY (G)	MAX GUNFIRE-SEC. (TOTAL) E 1	E 2	F 1	F 2	SEQUENCING
		PYLON					5			
			TANK (275) W/ANY FUEL	+4.0 -1.5	+3.2 -1.0					W/ TDU-11/B: DO NOT EXCEED 450 KIAS OR 0.95 IMN.
			TANK (275) EMPTY	+6.0 -2.0	+4.8 -1.5					
			TANK (150)							
			MK-84 LD	+5.0 -2.0	+4.0 -1.0					DO NOT EXCEED 1.30 IMN.
			SUU-20							
			MK-82							DO NOT EXCEED 1.20 IMN.
			MK-36							
			M129	+5.0 -1.0	+4.0 0					DO NOT EXCEED 600 KIAS OR 0.90 IMN.
			BLU							
			CBU							DO NOT EXCEED 1.02 IMN.
			MER W/ BOMBS	+5.0 -1.0	+4.0 0		5			DO NOT EXCEED 600 KIAS OR 1.20 IMN.
			MER EMPTY				5			

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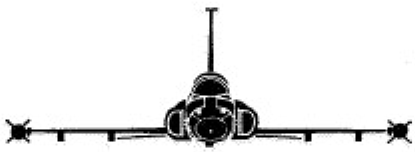
Figure 5-6 (Sheet 19).

IN-FLIGHT CARRIAGE & SEQUENCING LIMITATIONS

* CONFIGURATION LIMITS	
MAX SPEED:	710 KEAS OR 2.0 IMN (WHICHEVER IS LESS)
ACCELERATION LIMITS:	
SYM (G):	+7.33, -3.0
ROLL ENTRY (G):	+5.8, -1.0
W/INTERNAL FUEL MORE THAN 2200 LB:	
(E) 0.95 TO 2.0 IMN	
(F) 0.90 TO 2.0 IMN	
SYM (G):	+6.5, -3.0
ROLL ENTRY (G):	+5.2, -1.0

* MODIFY ABOVE LIMITS FOR THE SPECIFIC STORE-STATION CONFIGURATIONS LISTED BELOW.



TIP STORES

(OUTBD, INBD, & CL — NO PYLON/PYLON)

TIP	OUTBD	INBD	CL	OTHER LIMITATIONS						
				SYM (G)	ROLL ENTRY (G)	MAX GUNFIRE-SEC. (TOTAL) (E) (1)	MAX GUNFIRE-SEC. (TOTAL) (E) (2)	MAX GUNFIRE-SEC. (TOTAL) (F) (1)	MAX GUNFIRE-SEC. (TOTAL) (F) (2)	SEQUENCING
		PYLON					5			

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Figure 5-6 (Sheet 20).

EMPLOYMENT/RELEASE/JETTISON LIMITS

CAUTION

- THE EMPLOYMENT/RELEASE/JETTISON LIMITS FOR ANY ONE STORE SHALL NOT EXCEED CONFIGURATION CARRIAGE LIMITS.
- LANDING GEAR SHOULD BE UP FOR ALL STORES RELEASE/JETTISON IN FLIGHT.

STORE/ MUNITION	STATION				EMPLOYMENT				RELEASE-JETTISON				DIVE ∡ DEG	MANEU. FLAP	SPEED BRAKE	REMARKS
					AIRSPEED			G ACCEL	AIRSPEED			G ACCEL				
					MIN	MAX			MIN	MAX						
	TIP	OUT-BD	IN-BD	CL	KIAS	KIAS	*IMN		KIAS	KIAS	*IMN					
AIM-9	●				←(SAME AS CARRIAGE LIMITS)→								–	OPT	OPT	REFER TO T.O. 1F-5E-34-1-1 T.O. 1F-5E-34-1-1-2 T.O. 1F-5E-34-1-1-3
TDU-11/B	●				←(SAME AS CARRIAGE LIMITS)→								–	OPT	OPT	
PYLON (EMPTY)		●	●	●					250	375	0.85	+1.0	0	UP	IN	
TANK (150/275)				●					150	450	0.95	+1.0	0	UP	IN	
			●								0.85					
MK-82 LD				●					150	530 600	0.90 0.98	+1.5 TO +0.5	0-60	OPT	OPT IN	
		●	●							550	0.90				OPT	
MK-82 SE/ MK-36				●					150	❶ 450	0.90	+1.5 TO +0.5	0-60	OPT	IN	
		●	●							❶ 450	0.90				OPT	
MER				●					–	375	0.85	+1.0	0	UP	IN	LOADED OR EMPTY
MK-82 LD MK-82 SE					150	550 ❶ 450	0.90	+1.5 TO +0.5					0-60	OPT	IN	
MK-84 LD				●					–	520 640	0.95	+2.0 TO +0.5	0-60	OPT	OPT IN	
M129E2		●	●	●					170	400	0.85	+1.5 TO +0.5	0-45	UP	IN	
CBU				●					200	500 600	0.90 0.98	+2.0 TO +0.5	0-60	OPT	OPT IN	
		●	●							520	0.85				OPT	
LAU		●	●						170	400 360	0.85	+1.0	0	UP	IN	FULL EMPTY
2.75 FFAR						❷ 520	0.85	+1.5 +0.5					0-60	OPT	OPT	
SUU-20				●					150	400	0.85	+1.0	0	UP	IN	
2.75 FFAR						550	0.90	+1.5 +0.5					0-60	OPT	IN	SINGLE OR RIPPLE FIRE ONLY
BDU-33/ MK-106								+4.0 +0.5							OPT	
SUU-25		●							170	400	0.85	+1.0	0	UP	IN	LOADED OR EMPTY
FLARE/ MARKER					300	500	0.85	+1.0								

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Figure 5-7 (Sheet 1).

EMPLOYMENT/RELEASE/JETTISON LIMITS (CONTD)

STORE/ MUNITION	STATION				EMPLOYMENT				RELEASE-JETTISON				DIVE ∠ DEG	MANEU. FLAP	SPEED BRAKE	REMARKS
	TIP	OUT-BD	IN-BD	CL	AIRSPEED MIN KIAS	AIRSPEED MAX KIAS	AIRSPEED MAX *IMN	G ACCEL	AIRSPEED MIN KIAS	AIRSPEED MAX KIAS	AIRSPEED MAX *IMN	G ACCEL				
GBU-12 (HS)		●	●						200	550	0.90	+1.5 TO +0.5	0-60	OPT	OPT	
GBU-12 (LS)		●														
BLU				●					200	500	0.90	+1.5 TO +0.5	0-60	OPT	OPT	FINNED
										560					IN	
		●	●							❸500	0.85				OPT	
				●					200	500	0.90	+1.5 TO +0.5	0-30	OPT	OPT	UNFINNED
										540					IN	
		●	●							❸500	0.85	+1.5 TO +0.87	0-30	UP	OPT	
TDU-10/B		●			190	220	—	+1.0					0	MAN	IN	REFER TO T.O. 1F-5E-34-1-1

* WHICHEVER IS LESS.

❶ MAX SPEED 350 KIAS FOR FIN OPEN RELEASE (ARMED) WITH FINS MODE 0, 1, AND 2 INSTALLED.

Note

FIN MODS 0, 1, AND 2 ARE ATTACHED TO BOMB BODY WITH A SNAP RING AND GARTER SPRING AND DO NOT HAVE SETSCREW ACCESS HOLES IN FINS.

❷ MAX SPEED SALVO FIRING LAU-3/60:

475 KIAS W/STABILITY AUGMENTER ON.
425 KIAS W/STABILITY AUGMENTER OFF.

❸ WITH OUTBD BLU AND INBD TANKS, MAXIMUM RELEASE-JETTISON SPEED IS 475 KIAS OR 0.85 IMN (WHICHEVER IS LOWER), +0.87 TO +1.5-G ACCEL.

LEGEND

AIM-9	— AIM-9B, -9E, -9J, -9J-1
BLU	— BLU-1, -27, -32(F) OR (U)
CBU	— CBU-24, -49, -52, -58, -71
GBU-12 (HS)	— GBU-12/B, A/B (HIGH SPEED)
GBU-12 (LS)	— GBU-12A/B (LOW SPEED)
LAU	— LAU-3, -60, -68
MER	— BRU-27/A MULTIPLE EJECTOR RACK
OPT	— OPTIONAL

F-5 1-125(3)B

Figure 5-7 (Sheet 2).

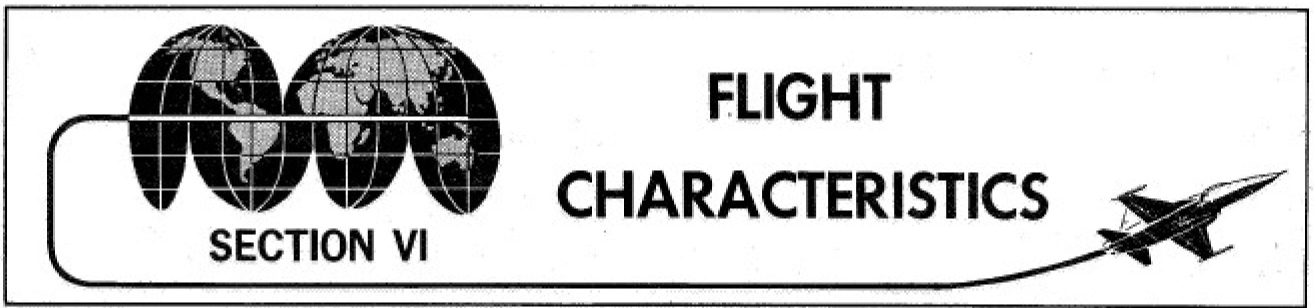

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TABLE OF CONTENTS

GENERAL FLIGHT CHARACTERISTICS

The aircraft is a high-performance, multipurpose tactical fighter with a primary mission of air superiority in the aerial combat maneuvering (ACM) environment. Maneuvering flaps are used to increase wing lift, delay buffet onset and generally improve the maneuver capability of the aircraft. Maneuvering flaps should be selected when initiating a maneuver above 1 g flight and the flaps retracted in less than 1 g flight. Flaps should be retracted when accelerating because of the reduced drag.

The two-axis (pitch and yaw) stability augmenter system provides improved flight characteristics. The aircraft can be maneuvered through-out the flight envelope with the augmenters disengaged with minimal degradation of flying qualities.

The aircraft can maneuver to the structural limiting g-load above 360 KIAS. Below 360 KIAS, the aircraft is aerodynamically lift-limited rather than structurally limited, and maximum lift capability is attained near stall AOA. Stall occurs at approximately 24 units AOA and is characterized primarily by the onset of wing rock and/or yaw oscillations (see STALLS). In most cases, full aft stick will produce AOAs above stall with a resultant increase in drag. In general, buffet onset (13 to 14 units AOA without flaps, 15 to 17 units AOA with flaps) can be used as a guide to indicate when maximum sustained level turn performance is attained.

Manuevering and handling qualities are degraded at lower airspeeds; therefore, a minimum of 300 KIAS should be maintained except for instrument approaches, maximum range descents, landings, and tactical maneuvering. The objective for establishing a minimum airspeed is to maintain a satisfactory energy state (i.e., "G" available) that will provide desired recovery response if an undesirable flight parameter is encountered below 15,000 ft. AGL.

CONTROL EFFECTIVENESS

PITCH

The horizontal tail provides satisfactory pitch control above 100 KIAS, but control decreases rapidly below 100 KIAS. In the 0.90 to 0.95 mach region with the clean aircraft, or near the limiting mach number with stores, pitch sensitivity is increased. This increased pitch sensitivity can produce g overshoots and may make the aircraft more difficult to trim, especially with the pitch damper off.

CAUTION

G-limit overshoot may occur if pitch inputs are applied too abruptly.

With maneuvering flaps, increased pitch sensitivity and lack of precise aircraft control will be apparent in pushovers to zero or negative-g flight conditions. This could lead to a negative-g overshoot giving the appearance of a runaway nose-down trim. Positive corrective action must be taken to stop the motion or the aircraft may enter into an inverted pitch hangup (IPH). IPH is a natural aircraft tendency to "hangup" at a negative g and is discussed under "Inverted Pitch Hangup". When attempting to accelerate near zero g, the flaps should be raised to reduce drag and the IPH tendency. Automatic shifting (auto shifts) of the manuevering flap transitioning cause pitch trim changes, and are most apparent above 0.90 Mach. Pitch trim changes will also occur with speed brake movement, and may either be nose-up or nose-down, depending on airspeed and altitude.

ROLL/YAW

Ailerons provide effective roll control below approximately 20 units AOA. Use of aileron (to the spring stop) produces high roll rates, particularly in the 0.80 to 0.95 Mach region, and can result in significant g increase due to roll coupling (see ROLL ENTRY G). Above approximately 20 units AOA, roll control with aileron is less effective and rudder is required to coordinate the maneuvers.

The rudder may be used throughout the flight envelope. It provides good roll control particularly at low airspeed and/or high AOA conditions. However, if the aircraft is flown to an AOA above stall, roll hesitations or oscillations will develop. At or near zero g the rudder will yaw but not roll the aircraft; as negative g increases, the aircraft will roll opposite the rudder input. The yaw stability augmenter reduces the effects of turbulence and aid in precise control of the aircraft.

ROLL ENTRY G

Roll entry g is established to avoid exceeding the maximum g limit during a rolling maneuver. Roll entry g should not be interpreted as the maximum permissible load factor during a rolling maneuver. A phenomenon called "roll coupling" causes the load factor to change during a roll. Normally, the load factor will increase during a roll depending on angle-of-attack, roll rate, etc. Roll entry g levels are established by determining the g level at which a maximum rate, 360-degree roll (aileron to the spring stop) can be initiated without exceeding the maximum allowable load factor. For example, an aircraft with an empty centerline fuel tank may enter a maximum rate rolling maneuver with 4.8 g established and be assured that 6.0 g will not be exceeded, provided no aft stick is applied during the manuever. The maximum allowable load factor differs with aircraft configuration and, therefore, various roll entry g levels have been established (see Section V).

Exceeding the aileron spring stop at the maximum allowable roll entry g will cause the maximum g limit to be exceeded. Rolling maneuvers can be initiated at g levels above the established roll entry g if less than a maximum rate roll is performed; however, some g increase will occur during the maneuver. Because of roll coupling, use care when applying abrupt aileron-plus-rudder in the same direction because g limit may be exceeded.

HIGH PITCH ATTITUDE/LOW AIRSPEED

When performing less than 75 degrees pitch attitude/low airspeed maneuvers, such as straight-ahead zooms, the aircraft can be maneuvered well below 1 g stall speed. With the controls trimmed to maintain the climb, no additional flight control input is required for recovery. The aircraft will pitch toward the horizon at approximately zero g until a diving attitude is achieved and flying speed is regained. If the trim is forward or if forward stick is applied during recovery from a zoom, the aircraft may pitch over and enter an inverted PSG or inverted spin. At pitch attitudes greater than 75 degrees, the recommended vertical recovery is a coordinated roll to the nearest horizon, maintain aft stick to bring the nose below the horizon and, as airspeed is regained, recover from inverted flight. It is important that this vertical recovery be initiated prior to reaching 100 KIAS during the zoom. If recovery is delayed and airspeed decreases below 100 KIAS, pitch control is not sufficient to control the aircraft, particularly if airspeed approaches zero. Aircraft recovery from high-pitch attitude zooms to near-zero airspeed typically occurs in one of three ways:

(1) If the pitch attitude has rotated past the nose-up vertical position, the nose falls through to an inverted wings-level attitude.
(2) If the pitch attitude has not reached the nose-up vertical, the aircraft pitches forward and overrotates through the nose-down vertical position to an inverted flight condition, or:
(3) Regardless of pitch attitude with respect to nose-up vertical, if the aircraft falls off on one wing, it may roll to inverted flight.

Regardless of the type of recovery, the aircraft typically ends up in inverted flight at low airspeed. Airspeed increases slowly while inverted and full aft stick is not effective in rotating the aircraft to a nose-down pitch attitude for recovery until airspeed increases above approximately 100 KIAS. While inverted the aircraft may yaw and roll and enter an inverted PSG or inverted spin. This can be a violent, disorienting maneuver, but is recoverable if sufficeint altitude is available (see INVERTED PSG/SPIN). The aircraft will remain in a 1 to 2 negative g condition while oscillating about all axes until recovery is accomplished.

WARNING

Initiate recovery prior to 100 KIAS during zooms in which pitch attitude exceeds approximately 75 degrees. If this pitch attitude is not decreased and airspeed is allowed to approach zero (allowing the aircraft to tail slide) before recovery is attempted, sufficient pitch control will not be available for immediate recovery and inverted PSG/spin entry is highly probable.

ERECT STALLS/POST-STALL GYRATIONS/SPINS Ⓔ

GENERAL

The clean aircraft resists departure from controlled flight, particularly when the cg is forward, and when maneuvering flaps are selected.

STALLS

Clean aircraft stall occurs at approximately 24-26 units AOA for all flap positions (see figure 6-1 for stall speeds), and will usually occur prior to reaching full aft stick.

With maneuvering flaps, buffet onset occurs at approximately 15-17 units AOA. The initial buffet is of light-to-moderate intensity and gradually increases as AOA is increased toward stall. One-g stalls with maneuvering flaps are characterized by a slight nose drop and onset of wing rock. If the stick is brought to full aft and held, the wing rock will continue and AOA may exceed 30 units (maximum readable on AOA gauge). As stall AOA is attained in accelerated stalls, the wing rock is accompanied by a decreased capability to maintain a g-level or turn rate. In accelerated stalls above 250 KIAS, minimum flap deflection is provided with maneuvering flaps selected and the wing rock may be initiated by a mild nose slice which usually causes the aircraft to roll out of turn. Precise aircraft control is regained immediately upon relaxing aft stick pressure to reduce AOA below stall which, in turn, terminates the wing rock. If the stall and/or full aft stick is maintained, the wing rock is sustained and frequency of the wing rock is increased over that observed in the 1-g stalls.

With flaps up, buffet onset occurs at approximately 13-14 units AOA and buffet intensity does not increase significantly as AOA is increased toward stall. Stalls with flaps up are generally characterized by a mild nose slice followed by wing rock. These post-stall motions are mild in 1-g stalls and the motions become more abrupt in accelerated stalls. However, as with maneuvering flaps, the stall is easily terminated by relaxing aft stick pressure. With cruise flaps, stall characteristics are essentially the same as those observed with flaps up.

As the cg moves aft, less aft stick movement is required to reach stall AOA (regardless of flap position) and consequently, application of full aft stick with aft cg provides more of a rotation capability beyond stall AOA. With sustained full aft stick the aircraft motions (primarily wing rock) will prevent precise aircraft control and the turning performance will be reduced from that obtained at AOAs below stall. If pitch control is applied abruptly to full aft stick from below stall AOA, the aircraft can achieve AOAs significantly in excess of 30 units and a PSG or spin entry may result.

WARNING

Application of full aft stick at near maximum rate from below stall AOA may result in PSG or spin entry.

STALL SPEED CHART

FLAPS AND/OR GEAR UP OR DOWN

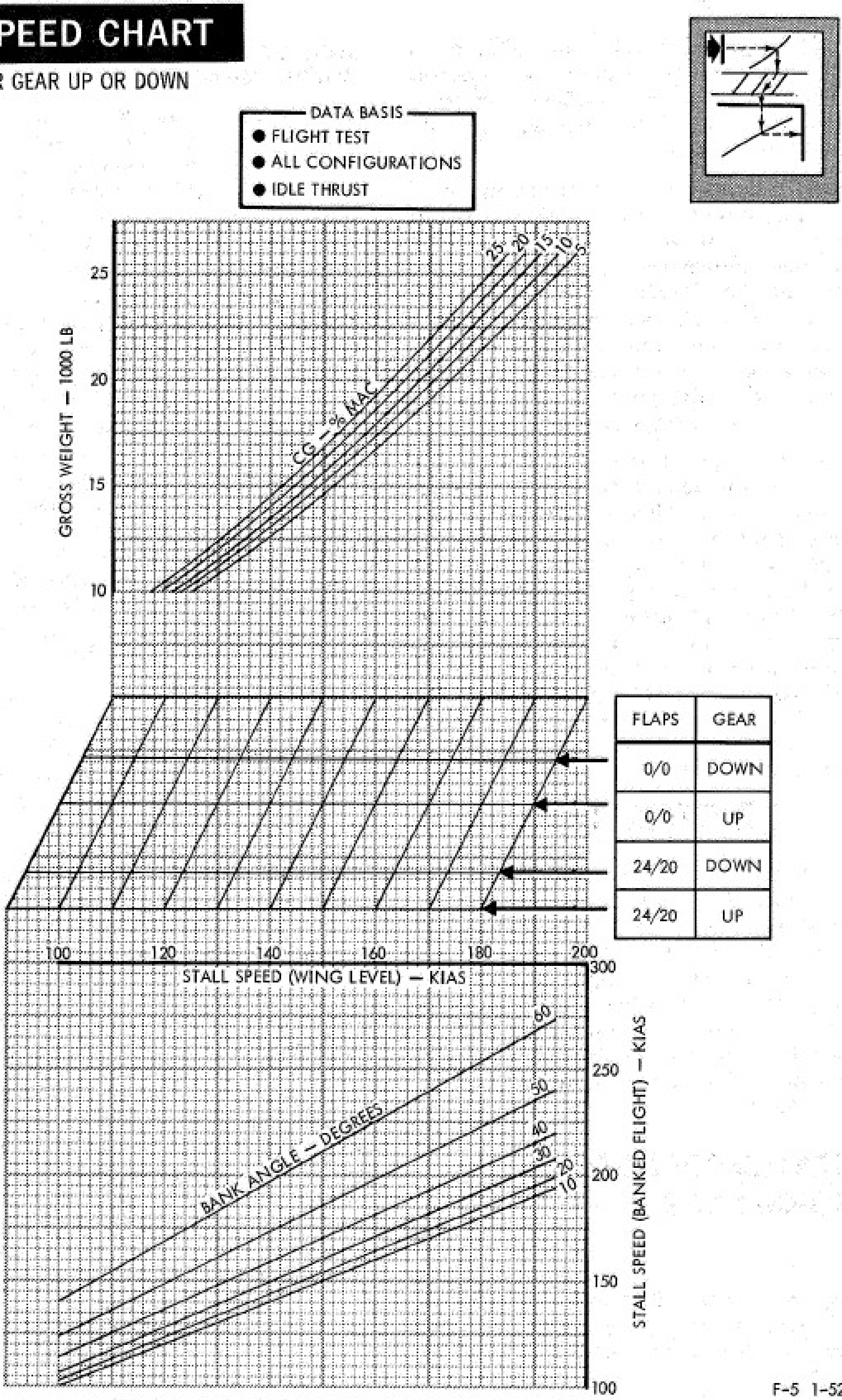

Figure 6-1.

POST-STALL GYRATIONS

A post-stall gyration (PSG) is continued uncontrolled aircraft motions at AOAs above stall. The uncontrolled motions of the PSG are continued yaw excursions, roll oscillations, and the inability to immediately reduce AOA below stall with release of aft stick pressure.

Flight tests have shown that the clean aircraft can be maneuvered beyond the stall AOA with little likelihood of entering a PSG. Maneuvering flaps and/or cg's forward of the aft limit increase resistance to PSG entry. Certain critical combinations of abrupt full rudder (or full crossed controls) in conjunction with full aft stick can produce PSGs or spins. PSGs or spins are most likely to occur when these control inputs are applied near stall AOA during decelerating turns, particularly when the pitch attitude is near or above the horizon. When full rudder is applied, in conjunction with full aft stick, the aircraft will yaw and roll in the direction of the rudder and simultaneously pitch to a high AOA resulting in a rapid deceleration. When stall AOA is exceeded, uncommanded roll hesitations or oscillations will usually be apparent. These motions are the best indications to relax aft stick pressure in order to regain precise aircraft control and avoid PSG/spin entry. A maneuver of this type, if prolonged, can produce sufficient AOA and yaw rate at low airspeed such that recovery to below stall may not be obtained by neutralizing rudder and aileron and relaxing aft stick pressure.

Allowing a PSG to continue will allow yaw rate to increase and the motion may then transition to a spin. Therefore, it is imperative that if recovery is not immediately achieved, forward stick (full forward, as required) be applied to reduce AOA and terminate the PSG. If this recovery action is promptly applied, spin entry is highly unlikely.

Initial aircraft response to forward stick may be slow and the AOA may appear to not be decreasing significantly. Probably the best indication that recovery is occurring is that airspeed is increasing toward 130 KIAS (rather than oscillating below 110 KIAS). A slight decrease in g, or a "lightening in the seat" may be noted as the aircraft pitches over on recovery. As the airspeed increases through approximately 130 KIAS, a strong pitchover will occur, indicating a successful recovery. Rolling during recovery may occur because of residual sideslip but this will subside and may be controlled with aileron. Aircraft pitch attitude upon recovery may be very nose low. Altitude loss during the PSG will vary but could be as much as 4000 feet. Because of the low airspeed and low pitch attitude at recovery, approximately 5000 to 7000 feet may be required for the dive pullout to regain level flight.

If forward stick is maintained after recovery, particularly with maneuvering flaps selected, the aircraft will pitch to negative AOA and may enter an IPH or inverted PSG/spin. Once recovery from the erect PSG has been established, aft stick should be applied smoothly to maintain or regain positive g flight and prevent entry into the IPH or inverted PSG/spin.

WARNING

Failure to relax forward stick on recovery from an erect PSG may cause the aircraft to enter an inverted PSG or inverted spin.

SPINS

If PSG recovery controls are not applied, or delayed until ineffective, the aircraft may enter an erect spin. During the development phase between PSG and the spin, yaw rate will increase and the direction of spin rotation will become apparent. Initially, the spin will more than likely be oscillatory, but may transition to a flat spin. The oscillatory spin is characterized by roll and pitch oscillations, pitch attitude approximately 30 degrees nose low, and a turn rate of approximately six seconds per turn. The flat spin is characterized by pitch attitude increasing toward, or on the horizon, and little, if any, pitch and roll motion and a turn rate of approximately four seconds per turn.

Altitude loss is approximately 1800 feet per turn in the oscillatory spin and approximately 1000 feet per turn in the flat spin. Airspeed during the oscillatory spin may be oscillating below approximately 110 KIAS (as in the PSG), but will probably be pegged near zero during the flat spin. Recovery from the oscillatory spin is possible but highly unlikely from the flat spin. The oscillatory spin may transition to the flat spin, even with proper spin recovery controls applied. Apply spin recovery controls as soon as the direction of spin is determined to obtain the best chance for spin recovery (see Section III for erect spin recovery procedures). Flight test results indicate that spin recovery may be improved somewhat by selecting maneuvering flaps if the spin was entered with flaps up. The benefit is limited compared to proper application of spin recovery controls. Do not sacrifice spin recovery controls in order to select maneuvering flaps for spin recovery.

If recovery from the oscillatory spin is occurring, early recovery indications will not be immediately obvious, as noted in the PSG recovery. Pitch attitude will gradually transition to an increasing nose-low attitude and average indicated airspeed should begin to gradually increase. As airspeed increases through approximately 130 KIAS, a strong pitchover will occur, much like the recovery from the PSG, indicating that recovery has occurred. Spin recovery will probably require a minimum of two turns and 4000 feet altitude loss, not including dive pullout. Pitch attitude upon recovery will be nose-low (similar to that obtained in the PSG recovery) and 5000 to 7000 feet of altitude loss will be required for the dive pullout to regain level flight.

If forward stick is maintained after recovery, the aircraft may pitch inverted and enter an inverted PSG/spin as described in the erect PSG section. When recovery is effected, smoothly apply aft stick to maintain or regain positive g flight.

WARNING

Failure to relax forward stick after recovery from an erect spin may cause the aircraft to enter an inverted PSG or inverted spin.

ERECT STALLS/POST-STALL GYRATIONS/SPINS Ⓕ

GENERAL

The clean aircraft resists departure from controlled flight below 29 units AOA. Stability deteriorates with increasing AOA above 29 units. Therefore, the aircraft is less resistant to departure from controlled flight above 29 units and becomes susceptible at more extreme AOAs which are more easily obtained with an aft cg.

STALLS

Clean aircraft stall occurs at approximately 24-27 units AOA for all flap positions (see figure 6-1 for stall speeds), and will usually occur prior to reaching full aft stick.

With maneuvering flaps, buffet onset occurs at approximately 15-17 units AOA. The initial buffet is of light-to-moderate intensity and gradually increases as AOA is increased toward stall. With flaps up, buffet onset occurs at approximately 13-14 units AOA and buffet intensity does not increase significantly as AOA is increased toward stall. One-g stalls are characterized by a slight nose drop and onset of wing rock. As stall AOA is attained in accelerated stalls, the wing rock is accompanied by a decreased capability to maintain a g-level or turn rate. The onset of wing rock during accelerated entries is more abrupt and frequency of oscillation is faster than during one-g stalls. Wing rock is terminated immediately upon relaxing aft stick pressure to reduce AOA below stall.

Less aft stick is required to generate stall AOA for relatively aft cg's (regardless of flap position) and, consequently, full aft stick provides more of a rotation capability at the aft cg's. Sustained full aft stick will generally not cause the aircraft to exceed 29 units AOA unless the aircraft is at an aft cg or full aft stick was abruptly applied. With an aft cg, wing rock and yaw excursions will increase in magnitude, AOA will increase well above 29 units, and PSG or spin entry may occur. Application of abrupt full aft stick from below stall AOA can achieve AOAs significantly in excess of 29 units and may result in PSG or spin entry.

WARNING

Prolonged full aft stick with an aft cg after stall or application of sustained full aft stick at maximum rate below stall AOA may result in PSG or spin entry.

POST-STALL GYRATIONS

A post-stall gyration (PSG) is continued uncontrolled aircraft motions at AOAs above stall. The uncontrolled motions of the PSG are continued yaw excursions, roll oscillations, and the inability to immediately reduce AOA below stall with release of aft stick pressure.

Flight test with clean aircraft has shown that sustained or abrupt full aft stick (see STALLS) or full rudder in conjunction with full aft stick can produce PSGs or spins. PSGs or spins are most likely to occur during maneuvering flight when full rudder and full aft stick inputs are applied near stall AOA. When full rudder is applied in conjunction with full aft stick, the aircraft will initially yaw and roll in the direction of the rudder and simultaneously pitch to high AOA resulting in rapid deceleration. When stall AOA is exceeded, uncommanded roll hesitations or oscillations will usually be apparent. These motions are the best indications to relax aft stick pressure in order to regain precise aircraft control and avoid PSG/spin entry. A maneuver of this type can produce sufficient AOA (well above 29 units) and yaw rate at low airspeed such that PSG or spin entry may occur. With cg's near the aft limit, these higher AOAs are more easily obtained. Maneuvering flaps increase the roll-yaw stability of the aircraft and increase its resistance to PSG entry. Flaps up allows a higher initial yaw rate to be established with rudder inputs than if maneuvering flaps are used.

WARNING

Maneuvering flight at high AOA should only be performed using maneuvering flaps. Use of maneuvering flaps increases the aircraft's resistance to PSG/spin entry.

Allowing a PSG to continue will allow yaw rate to increase and the motion may then transition to a spin. Therefore, it is imperative that forward stick (full forward, as required) be applied immediately to reduce AOA and terminate the PSG. If this recovery action is delayed, spin entry may occur.

Initial aircraft response to forward stick may be slow and AOA may appear to not be decreasing significantly. Probably the best indication that recovery is occurring is that airspeed is increasing toward 130 KIAS (rather than oscillating below 110 KIAS). A slight decrease in g, or a "lightening in the seat" may be noted as the aircraft pitches over on recovery. As the airspeed increases through approximately 130 KIAS, a strong pitchover will occur, indicating a successful recovery. Rolling during recovery may occur because of residual sideslip but will subside and may be controlled with aileron. Aircraft pitch attitude upon recovery may be very nose-low. Altitude loss during the PSG will vary but could be as much as 4000 feet. Because of the low airspeed and low pitch attitude at recovery, approximately 5000 to 7000 feet may be required for the dive pullout to regain level flight.

If forward stick is maintained after recovery, particularly with maneuvering flaps selected, the aircraft will pitch to negative AOA and may enter an IPH or inverted PSG/spin. Once recovery from the erect PSG has been established, aft stick should be applied smoothly to maintain or regain positive g flight and prevent entry into the IPH or inverted PSG/spin.

WARNING

Failure to relax forward stick on recovery from an erect PSG may cause the aircraft to enter an inverted PSG or inverted spin.

SPINS

If PSG recovery controls are not applied, or delayed until ineffective, the aircraft may enter an erect spin. During the development phase between the PSG and the spin, yaw rate will increase and the direction of spin rotation will become apparent. Initially, the spin will more than likely be oscillatory, but may transition to a flat spin. With an aft cg, the spin will probably be flat. The oscillatory spin is characterized by roll and pitch oscillations and an airspeed oscillating below 110 KIAS. The flat spin is characterized by pitch attitude increasing toward or on the horizon, and little (if any) pitch and roll motion and near zero airspeed. Altitude loss is approximately 1,700 feet per turn with a turn rate of 6 to 7 seconds per turn in the oscillatory spin and approximately 1,400 feet per turn with a turn rate of 5 seconds in the flat spin. Airspeed during the oscillatory spin may be oscillating below approximately 100 KIAS (as in the PSG), but will probably be pegged near zero during the flat spin. Recovery from the oscillatory spin is possible but highly unlikely from the flat spin. However, the oscillatory spin may transition to the flat spin, even with proper spin recovery controls applied. Apply spin recovery controls as soon as the direction of spin is determined to obtain the best chance for spin recovery (see section III for erect spin recovery procedures). Flight test results indicate that spin recovery may be improved somewhat by selecting maneuvering flaps if the spin was entered with flaps up. The benefit is limited compared to proper application of spin recovery controls. Do not sacrifice spin recovery controls in order to select maneuvering flaps for spin recovery.

If recovery from the oscillatory spin is occurring, early recovery indications will not be immediately obvious, as noted in the PSG recovery. Pitch attitude will gradually transition to an increasing nose-low attitude and average indicated airspeed should begin to gradually increase. As airspeed increases through approximately 130 KIAS, a strong pitchover will occur, much like the recovery from the PSG, indicating that recovery has occurred. Spin recovery will probably require a minimum of two turns and 4500 feet altitude loss, not including dive pullout. Pitch attitude upon recovery will be nose-low (similar to that obtained in the PSG recovery) and 5000 to 7000 feet of altitude loss will be required for the dive pullout to regain level flight.

If forward stick is maintained after recovery, the aircraft may pitch inverted and enter an inverted PSG/spin as described in the erect PSG section. When recovery is effected, smoothly apply aft stick to maintain or regain positive g flight.

WARNING

Failure to relax forward stick after recovery from an erect spin may cause the aircraft to enter an inverted PSG or inverted spin.

INVERTED FLIGHT CHARACTERISTICS

INVERTED PITCH HANGUP (IPH)

Inverted pitch hangup (IPH) is the tendency for the aircraft to stabilize or "hang" at negative g (AOA generally pegged at zero units) if aft stick is not applied to maintain positive-g flight. When flown at negative g near zero units AOA, the aircraft exhibits a tendency to tuck to a slightly more negative g and stabilize "hands off". The IPH tendency exists for all configurations and airspeeds, but is more prevalent below 300 KIAS with maneuvering flaps and a relative aft cg condition with the pitch trim less than +3 units. The IPH can be encountered from normal inverted flight or from various erect maneuvers, such as improper vertical recovery. If recovery from the IPH is not accomplished, divergent roll oscillations or an inverted spiral may develop. If the inverted spiral is allowed to progress, and inverted PSG/spin will result. If an IPH is encountered, the following recovery procedure should be used:

a. Select flaps up.
b. Apply aft stick as required to reduce negative g (increase AOA) until positive-g flight is reestablished.

INVERTED PSG/SPIN

An inverted PSG/spin is characterized by violent, disorienting oscillations about all three axes following an inverted stall. The inverted PSG/spin may be encountered following an extended IPH. It may also be encountered following erect PSG or spin recovery, from improper vertical recoveries, or from rudder rolls to inverted flight. In these three cases, the inverted PSG/spin will probably not be preceded by the IPH. Maneuvering flaps and/or aft cg tend to expedite an inverted PSG/spin entry. The motion is dominated by the large pitch oscillations but has roll and yaw oscillations superimposed. The aircraft will continue to pitch, roll, and yaw violently in what appears to be a random manner, and continuous negative g will be sensed. The inverted PSG/spin is recoverable if sufficient recovery altitude is available (see Section III for inverted PSG/spin recovery procedures). Altitude loss during inverted PSG/spin recovery will vary, but will be at least 3500 feet and may exceed 6000 feet (not including dive pullout). For recovery, flaps up should be selected first, primarily because of added pitch stability provided at negative g with flaps up versus maneuvering flaps. Then, apply smooth aft stick as necessary to regain positive-g flight. The best indication of recovery from the inverted PSG/spin is the decrease of negative g and the onset of positive g. The aircraft will always recover from the inverted PSG/spin if sufficient altitude is available, but some additional negative pitch oscillations (typically 1 to 3) may occur after recovery has been initiated. If considerable aft stick (or full aft stick) is maintained after recovery, the aircraft may quickly transition to an extreme positive AOA on recovery and, dependent on other aircraft motions (primarily yaw rate), entry into an erect PSG or spin is possible. Aileron and rudder should not be used to aid recovery from the inverted PSG/spin because:

(1) A sustained turn direction is difficult to determine because of the extremely oscillatory and disorienting aircraft motions, and
(2) Aileron or rudder may cause the aircraft to transition quickly to an upright (erect) PSG or spin from which recovery is more difficult.

WARNING

If recovery from out-of-control flight has not been attained by 15,000 feet AGL, eject.

STORE EFFECTS

CENTERLINE STORES

Resistance to departure from controlled flight is significantly reduced if centerline stores are carried. With centerline stores, the aircraft is susceptible to PSGs and spins if AOA exceeds 20 units. The aircraft is more susceptible to PSGs and spins with flaps up. Do not exceed 20 units AOA when centerline stores are carried regardless of flap position.

Carriage of centerline stores (excluding pylon only) causes an aerodynamic effect which reduces the yaw stability. Approach-to-stall characteristics with centerline stores are essentially the same as that obtained with the clean aircraft. However, if stall AOA is attained or exceeded, the aircraft can exhibit large excursions about all three axes and post-stall gyrations will be significantly more abrupt and oscillatory than with the clean aircraft. The post-stall motions are more exaggerated with large stores than with small stores (i.e., 275-gallon tank versus SUU-20 dispenser). During 1-g stalls with centerline stores, the aircraft has a tendency to exhibit a pure nose-slice (yaw) followed by roll oscillations. These post-stall motions are relatively mild in 1-g stalls and can generally be terminated by releasing aft stick pressure to reduce AOA to below stall. In accelerated stalls an abrupt nose-slice occurs followed by very rapid roll and yaw oscillations. Resulting side forces will be apparent to the pilot. The AOA will also abruptly increase to beyond 30 units. Normal PSG recovery procedures should effect a satisfactory recovery if applied soon enough. If releasing aft stick does not produce a pitch response, full forward stick should be applied immediately. If PSG recovery controls are not applied immediately, spin entry may occur rapidly. The initial turn rate during the spin may be very slow and difficult to recognize because of the large pitch and roll oscillations. However, as soon as the turn direction is recognized, normal spin recovery controls should be applied immediately. Altitude loss per turn during the spin will be approximately the same as with the clean aircraft but recovery from either the PSG or spin with a centerline store may be slower than with the clean aircraft.

When wing stores are carried in conjunction with a centerline store, stall/post-stall characteristics are similar to those described under CENTERLINE STORES. However, because of the increased roll and yaw inertia due to the wing stores, the post-stall roll/yaw oscillations take longer to develop, but also take longer to stop. Following the nose slice at stall AOA, the post-stall motion will be primarily in yaw with significantly less rolling tendency (due to the increased roll inertia) than with centerline stores only. Therefore, to preclude PSG/spin entry, do not exceed 20 units AOA when centerline stores are carried.

SYMMETRIC WING STORES

With symmetric wing stores, several distinct aircraft characteristics occur. Power changes produce noticeable pitch changes. These pitch changes are more pronounced for heavy store loading and/or as the cg moves toward the aft limit. Use of speed brakes, especially at high speed, low altitude, also causes pitch changes. Pitch control becomes more sensitive with speed brakes extended. With maneuver flaps down, pushovers to negative g can result in a slight negative g overshoot. The amount of overshoot is a function of stick rate and is greatest at 220 KIAS. Salvo of 4 or 5 firebombs or simultaneous release of outboard firebombs at high airspeeds and less than 1 g will cause an abrupt instantaneous pitch response. There is no change to aircraft flight path and the aircraft will return to the prerelease flight conditions without pilot actions.

ASYMMETRIC STORES

A single AIM-9 missile is not an asymmetry. Aileron or rudder trim requirements to compensate for the single missile are negligible. During erect stalls, either 1-g or accelerated, there are no noticeable rolling tendencies due to the missile nor are there any erect post-stall characteristics unique to the single missile. Inverted characteristics are affected to the extent that the inverted spiral is generally biased in the direction of the missile. There are no unique characteristics in the inverted PSG/spin or recovery modes due to the single missile.

An asymmetric pylon store loading is very susceptible to PSG/spin entry if 20 units AOA is exceeded. Therefore, do not exceed 20 units if an asymmetric pylon store loading exists.

Aircraft flight characteristics with asymmetric pylon store loadings are affected primarily by weight imbalance. These effects are more noticeable at lower airspeeds or during maneuvering flight. At low AOA, rudder trim is sufficient to trim out yaw produced by asymmetric loads. Available aileron trim may be exceeded and have to be supported by stick forces at low speeds. If possible, the asymmetric pylon stores should be jettisoned prior to landing. However, if landing is attempted, a flat straight-in approach, with little flare, should be made to accomplish a smooth touchdown. Be alert for possible wing drop during roundout. The approach and landing should be carefully planned and executed, considering the runway length, crosswind and increased approach speed. During landing roll with asymmetric pylon stores, caution should be used when braking because the aircraft will have a tendency to turn away from the store-loaded wing.

High AOA characteristics with asymmetric pylon stores are very noticeable to the pilot. During the approach to a stall, there is a steadily increasing rolling tendency into the heavy wing and there may be insufficient aileron to counter the roll. Coordinated rudder, however, will control the roll. As stall AOA (approximately 24 units) is reached, the aircraft motions change abruptly, and the aircraft yaws and rolls strongly away from the heavy wing. If the aircraft is maintained in a stall, the yaw will continue, the AOA will increase, and the aircraft may progress into a spin (Ⓔ highly oscillatory spin). These motions are most abrupt in accelerated stalls, increasing the likelihood of spin entry. With Ⓔ, the asymmetry tends to keep the spin oscillatory, but the flat spin mode may also be encountered. Turn rates during the spin will be similar to that of the clean aircraft. Altitude loss per turn will be increased slightly over that of the clean aircraft. With spin recovery control applied, recovery is very slow with light asymmetries, and may be non-existent with heavy asymmetries. Therefore, to preclude PSG/spin entry with asymmetric pylon stores, do not exceed 20 units AOA. With Ⓕ, the spin will probably be flat but may initially exhibit more roll oscillations than during a flat spin with the clean aircraft. Turn rates during the spin will be faster than those of the clean aircraft flat spin, approximately 4 seconds per turn. Spin recovery is highly unlikely with any asymmetric pylon loading. Therefore, to preclude PSG/spin entry with asymmetric pylon stores, do not exceed 20 units AOA.

EXTERNAL STORE JETTISON

Do not jettison external stores while aircraft is out of control.

DRAG CHUTE

Do not use the drag chute as a spin recovery device because of the following undetermined factors:

(1) Deployment
(2) Effectiveness
(3) Ejection seat-to-chute clearance
(4) Structural failure

AIRCRAFT CONFIGURATION EFFECTS

Gear position, speed brake position, stability augmenter status, and engine power setting (symmetric or asymmetric) have no significant effect on stall/post-stall characteristics.

ENGINE OPERATING CHARACTERISTICS

If a PSG/spin is encountered with the engines at high power setting (above approximately 95 percent RPM) flameout of one or both engines is probable. If both engines flameout, generator dropout will occur at approximately 43 percent RPM leaving only battery power available. As engine RPM decays, any flight control movement will rapidly deplete the hydraulic pressure.

AOA INDICATOR

The AOA indicator provides accurate information up to the stall. However, above the stall, AOA indications become oscillatory and unreliable because of sideslip oscillations. AOAs obtained during erect PSGs and spins are significantly greater than 30 units and the AOA indicator will generally be pegged at the maximum reading. However, sideslip oscillations during the PSG or spin may cause the AOA indicator to intermittently, and erroneously read less than 30 units. Erroneous indications below 30 units may lead to premature release of PSG or spin recovery controls, therefore, the AOA indicator should not be used to provide an indication of PSG/spin recovery.

DIVE RECOVERY

Steep dives at high speeds at low altitudes should be avoided because of the large altitude loss during recovery. (See figure 6-2.) Should a high-speed, steep dive be entered at low altitude, the speed brake should be extended immediately. Use of speed brake does not restrict g attainable.

HIGH MACH DIVES

Maximum Mach Dives Ⓔ

The maximum mach number profile is defined by the maximum mach dive shown in figure 6-3 for a standard day. The dive is initiated by a pushover from 40,000 feet and 1.58 mach at MAX thrust and is based upon a constant 0g load factor, held until recovery. At 27,000 feet, mach 1.74, and a dive angle of 31 degrees, reduce thrust to MIL and start a 4g pullout (use approximately 2 seconds to build g from 0 to 4.0). Recovery to level flight should be completed at approximately 21,000 feet at mach 1.5, having lost 6000 feet from the start of the recovery.

Maximum Mach Dives Ⓕ

The maximum mach number profile is defined by the maximum mach dive shown in figure 6-4 for a standard day. The dive is initiated by a pushover from 43,000 feet and 1.41 mach at MAX thrust and is based upon a constant zero g load factor, held until recovery. At 26,000 feet, mach 1.69, and a dive angle of 38 degrees, reduce thrust to MIL and start a 4 g pullout (use approximately 2 seconds to build g from 0 to 4.0). Recovery to level flight should be completed at approximately 18,000 feet at mach 1.40 having lost 8000 feet from the start of the recovery.

Shallow Dive Ⓔ

The limit speed is more easily attained by pushing over at MAX thrust into a shallow dive from 29,000 feet at mach 1.5 (see figure 6-3). Continue a gradual pushover until 16 degrees is reached at approximately 17,500 feet. With 16 degrees dive angle, mach 1.5, and 17,500 feet, start a 4g pullout, using approximately 2 seconds to build to 4g. Recovery should be completed at 15,000 feet, having lost 2500 feet in the pullout.

Shallow Dive Ⓕ

The limit speed is more easily attained by pushing over at MAX thrust into a shallow dive from 32,500 feet at mach 1.5 (see figure 6-4). Continue a gradual pushover until 19 degrees is reached at approximately 17,500 feet. With 19 degrees dive angle, mach 1.5 and 17,500 feet, start a 4 g pullout, using 2 seconds (approx.) to build to 4 g. Recovery should be completed at 15,000 feet, having lost 2500 feet in the pullout.

SPEED PROFILES

The speed profiles are shown in figure 6-5. Maximum thrust is maintained in the dive to the start of pullout at which time the thrust of both engines is reduced to military thrust. The lift limits are based on maximum lift conditions at the prevailing mach numbers.

DIVE RECOVERY CHART

EXAMPLE:

IF 4.0-G PULLOUT FROM A 30° DIVE AT 600 KIAS IS STARTED AT 25,000 FT, THE ALTITUDE LOST DURING DIVE RECOVERY WILL BE 3800 FT.

(1) ENTER CHART WITH KIAS AT START OF PULLOUT — 600 KT.

(2) PROCEED RIGHT TO ALTITUDE PULLOUT STARTED — 25,000 FT.

(3) THEN DOWN TO DIVE ANGLE — 30 DEG.

(4) PROJECT RIGHT AND INTERSECT:

(5) DIVE RECOVERY LOAD FACTOR — 4.0 G.

(6) READ ALTITUDE LOSS DURING PULLOUT — 3800 FT.

Note

IF KTAS IS KNOWN, ENTER CHART WITH KTAS AT START OF PULLOUT, PROCEED UP TO THE DIVE ANGLE, AND REPEAT STEPS (4), (5), AND (6).

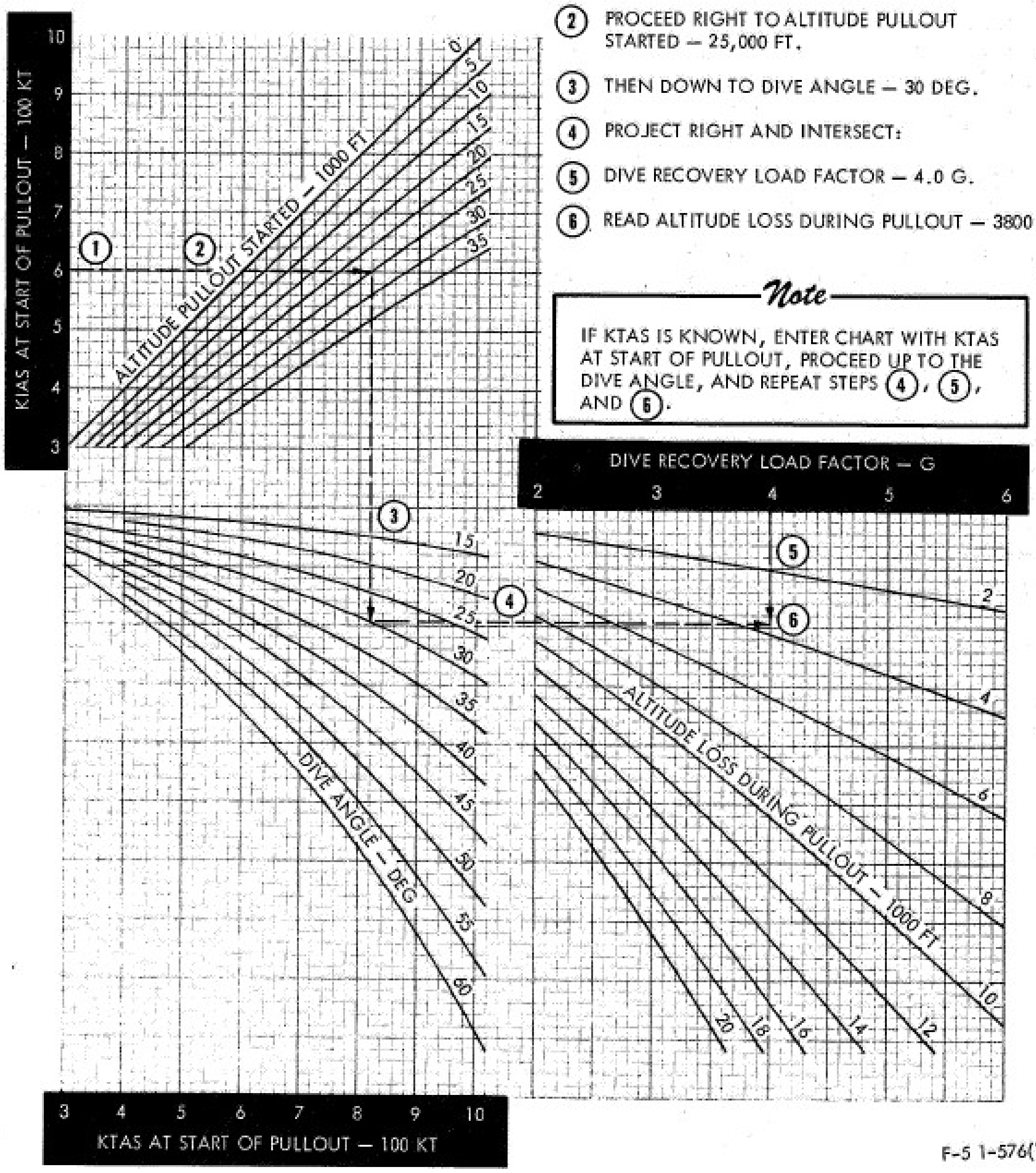

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Figure 6-2.

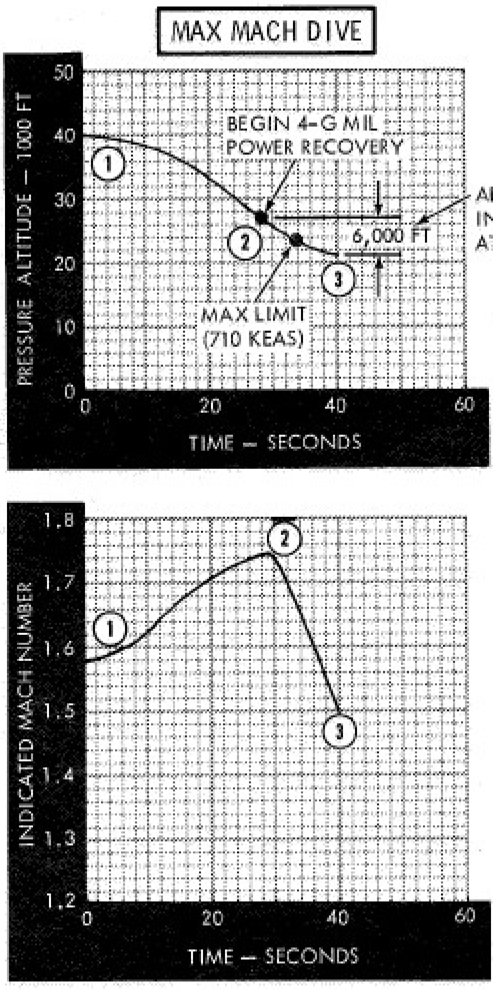
HIGH MACH DIVES

E

STANDARD DAY — GROSS WEIGHT — 13,300 POUNDS

DATA BASIS: **FLIGHT TEST**

TIP LAUNCHER RAILS



Note

1. BEGIN ZERO-G MAXIMUM THRUST DIVE ENTRY.
2. ATTAIN 31° DIVE ANGLE. REDUCE THRUST TO MIL AND BEGIN 4-G DIVE RECOVERY AT 27,000 FT.
3. END DIVE RECOVERY IN LEVEL FLIGHT ATTITUDE.

WARNING

INITIATE DIVE RECOVERY AT 27,000 FEET MINIMUM TO PREVENT EXCEEDING STRUCTURAL LIMIT.

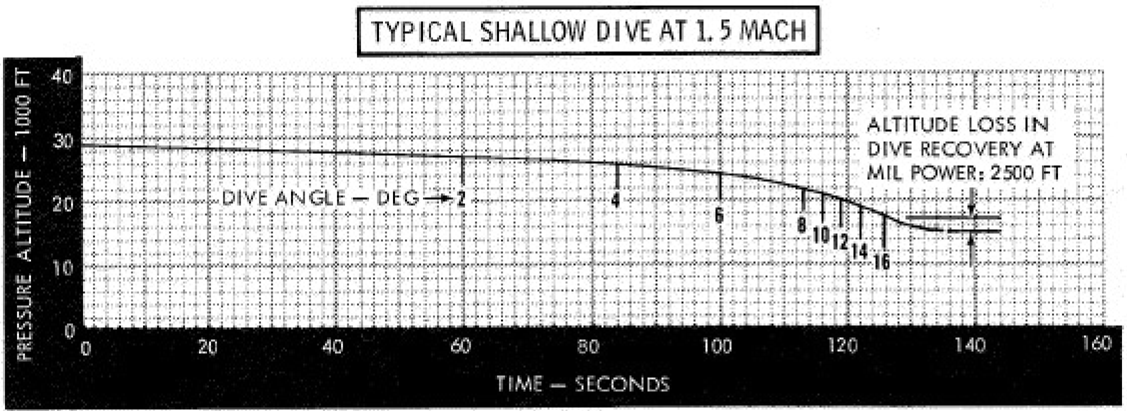


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Figure 6-3.

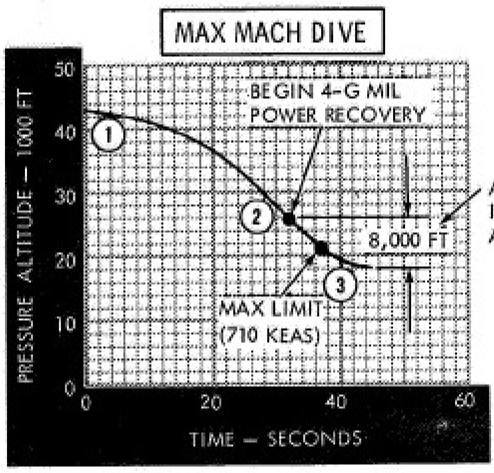
HIGH MACH DIVES

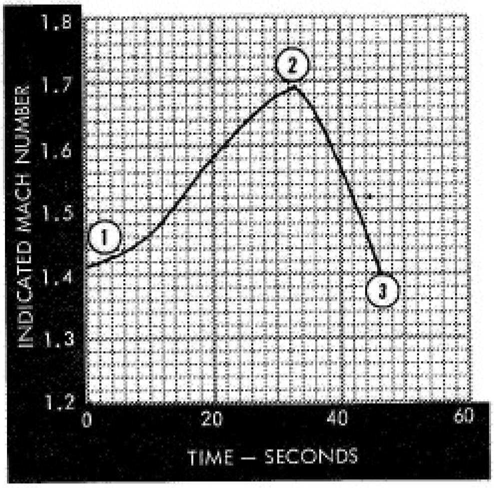
F

STANDARD DAY — GROSS WEIGHT 13, 800 POUNDS

DATA BASIS: **FLIGHT TEST**

TIP LAUNCHER RAILS





Note

1. BEGIN ZERO-G MAXIMUM THRUST DIVE ENTRY.
2. ATTAIN 38° DIVE ANGLE. REDUCE THRUST TO MIL AND BEGIN 4-G DIVE RECOVERY AT 26,000 FT.
3. END DIVE RECOVERY IN LEVEL FLIGHT ATTITUDE.

WARNING

INITIATE DIVE RECOVERY AT 26,000 FEET MINIMUM TO PREVENT EXCEEDING STRUCTURAL LIMIT.

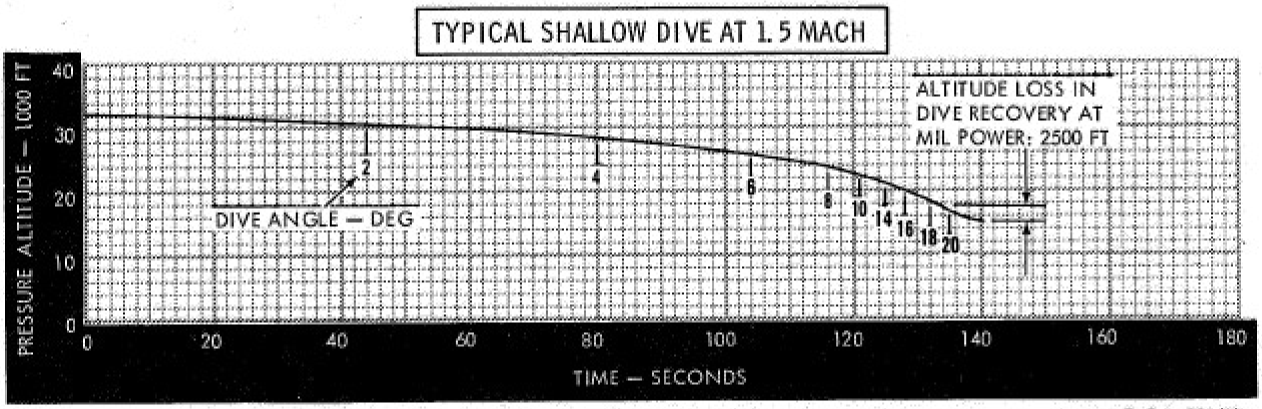


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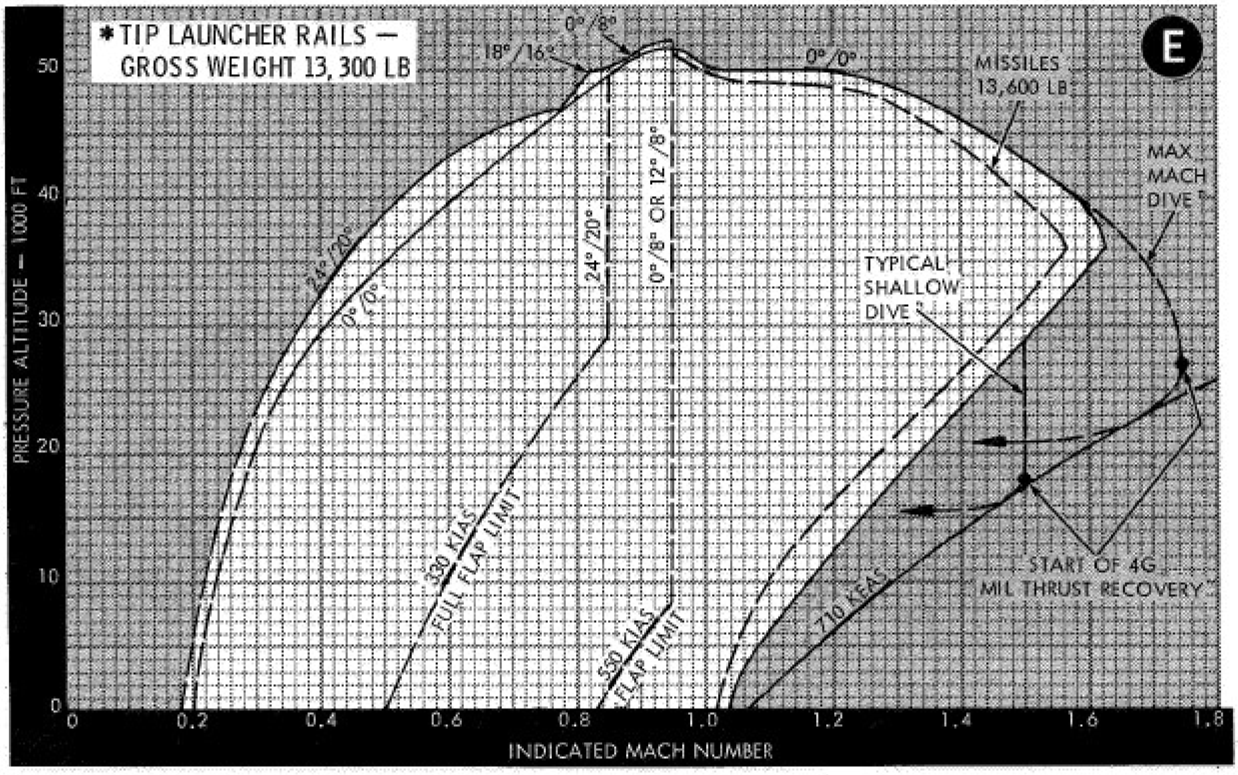
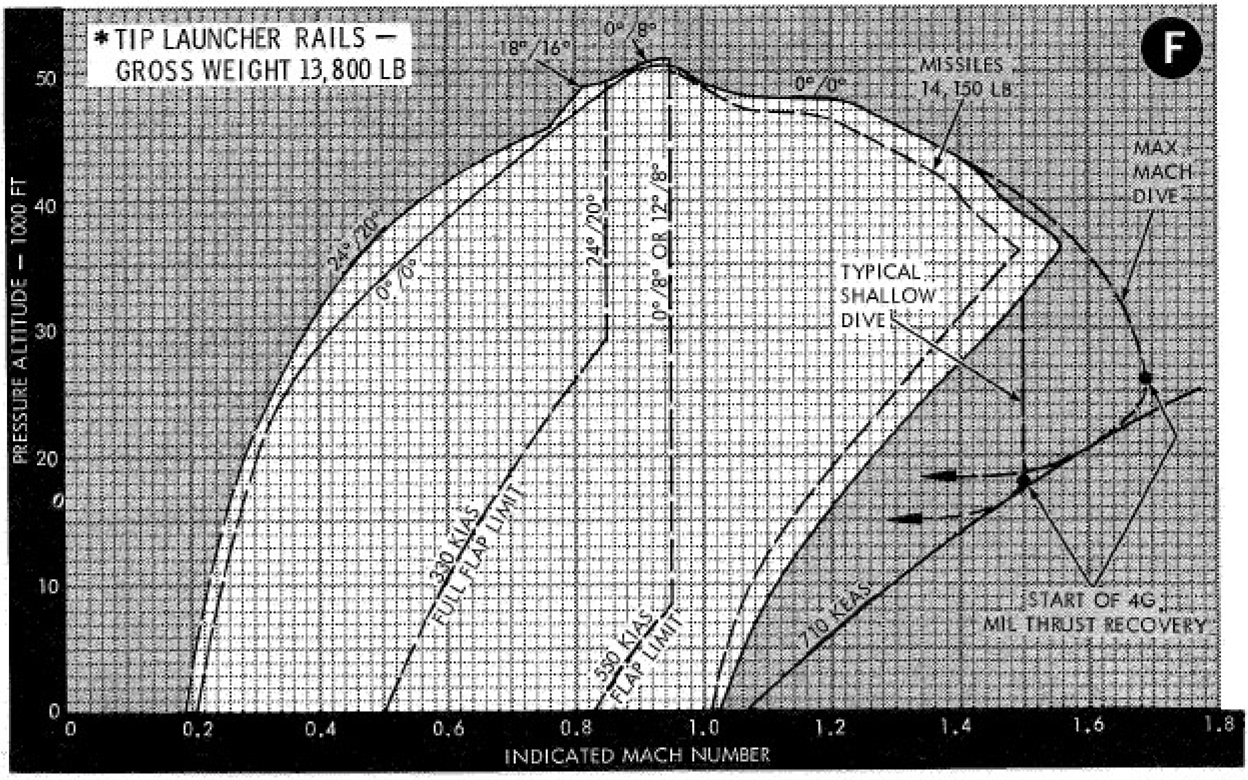
Figure 6-4.

SPEED PROFILE MAX THRUST

> **Note**
> CHART DATA BASED ON STANDARD DAY AND 1-G CONDITIONS.





*EXCEPT AS NOTED

F-5 1-536(1)C

Figure 6-5.

ADVERSE WEATHER OPERATION

SECTION VII

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TABLE OF CONTENTS

INTRODUCTION

This section contains discussion, explanation, operational peculiarities, and procedures which affect operation of the aircraft in extreme weather and climatic conditions. Normal instrument flight procedures are covered in section II.

ICE AND RAIN

ICING CONDITIONS

Each aircraft is provided with engine anti-ice, pitot heat, AOA vane heat, and canopy and windshield defog for adverse weather operation. Icing conditions which may be encountered are trace, light, moderate, and severe. Moderate and severe icing, particularly, can cause rapid buildup of ice on aircraft surfaces, greatly affecting performance. Short duration climbs and descents may be made thru light icing conditions.

WARNING

The aircraft should not be flown in moderate or severe icing conditions. If any icing is encountered, leave the area of icing conditions as soon as possible. If flight in icing conditions results in ice accumulation on the aircraft, enter this fact in the Form 781; engines must be inspected for ice ingestion damage when this occurs.

Ice accumulation on the engine inlet duct lips may cause engine damage. The entry of ice into an engine may cause a jar, vibration, or noise in the engine and damage the inlet guide vanes and first-stage compressor blades. Instrument indications may remain normal even though damage and loss of thrust have occurred.

When icing conditions are anticipated, the pitot heat and engine anti-ice switches and the canopy defog rheostat switch should be turned on ((F) [E-1] canopy defog rheostat switch turned to full increase).

NOTE

- (E) EXCEPT [E-1] Anti-icing and canopy and windshield defog systems will operate down to 75% rpm.
- (F) [E-1] To ensure effective anti-icing, maintain at least 80% rpm when anti-icing system is turned on. Canopy and windshield defog systems will operate at any engine rpm.

WET OR SLIPPERY RUNWAY

Takeoff

On icy or wet runways, the aircraft may skid during MIL power runup even though the brakes are locked. It may be necessary to run up one engine at a time, and to start the takeoff roll at less than MIL power.

Landing

Normal landing procedures should be used. Landing ground roll distances are significantly increased on a wet or slippery runway. After nosewheel is lowered, apply brakes carefully. Avoid locking the brakes. Hydroplaning and/or tire skidding on a wet or icy runway will increase stopping distance and can easily result in loss of directional control. Taxi carefully, as nosewheel steering can be relatively ineffective on a wet or slippery runway.

CAUTION

- Painted areas on runways, taxiways, and ramps are significantly more slippery than unpainted areas.
- When conditions of snow or ice exist, approach ends of runways are usually more slippery than any other areas due to the melting and refreezing of ice and snow at this location.

RUNWAY CONDITION READING (RCR) WET RUNWAYS

The Runway Condition Reading (RCR) is an indication of the expected braking performance of the aircraft. All charts involving stopping distance are based on an RCR value of 23 for a dry pavement condition. Wet runway surfaces will increase the stopping distance.

CAUTION

RCR values can only provide an approximation of the required stopping distance for the aircraft. Wet RCR values are valid only when hydroplaning does not occur. If hydroplaning occurs, it is not possible to predict the actual stopping distance.

The rubber buildup on the touchdown areas of the runway will reduce the braking efficiency of the aircraft. The ground roll approximated by the RCR charts after applications of the RCR correction factor is based on that portion of the runway between the two touchdown areas. In situations where the estimated landing roll will include the touchdown area at the opposite end of the runway, speed should be reduced as much as possible before entering this area, since less traction for braking can be expected.

The depth of the water may vary at different locations on the runway. Water depth on runway surfaces is influenced by the drainage characteristics and texture of the pavement surface.

HYDROPLANING FACTORS

Hydroplaning is a phenomenon with many variables. If hydroplaning is expected during landing, use drag chute or aerodynamic braking to slow aircraft as much as possible before applying wheel brakes. Hydroplaning may occur above 85 KIAS.

Certain factors should be considered when planning a takeoff or landing on a wet or damp runway.

1. Tires approaching the wear limits are more likely to hydroplane than new tires. Also, if the tire pressures are low, hydroplaning will occur at a lower speed.
2. Avoid immediate application of the wheel brakes after touchdown to allow full wheel spin up. When using wheel brakes, be prepared to immediately release and reapply the brakes upon first indication of skidding or unusual yaw.
3. Crosswind components above the maximum safe velocities will cause the aircraft to drift laterally if hydroplaning occurs.
4. The advantages of delayed landing or proceeding to an alternate airfield should be considered when hydroplaning potential is high.

ENGINE ICING

Engine inlet guide vane icing may occur when ambient temperature is below 40°F and visible moisture is present. Under these conditions and when icing conditions are anticipated, the engine anti-ice switch should be immediately placed in the ENGINE position. This action ensures continuing anti-ice action.

NOTE

To ensure effective anti-icing, maintain at least 75% rpm when engine anti-icing system is turned ON.

TURBULENCE AND THUNDERSTORMS

Flight in turbulent air, hailstorms, and thunderstorms should be avoided because of the high probability of damage to airframe and components from impact ice, hail, and lightning. If entry into adverse weather cannot be avoided, turn on engine anti-ice and pitot heat prior to penetration.

TURBULENT AIR PENETRATION PROCEDURES

CAUTION

Flight thru thunderstorms or extreme turbulence must be avoided whenever possible. Maximum use of weather forecast and radar facilities to help avoid thunderstorms and turbulence is essential.

If flight thru these areas cannot be avoided, the following procedures should be followed:

1. Airspeed — Establish 300 KIAS and trim for level flight. Severe turbulence will cause large and rapid variations in airspeed. Do not change thrust except for extreme airspeed variations.
2. Attitude — Attitude is the primary reference in extreme turbulence. Pitch and bank should be controlled by reference to the attitude indicator. Do not change trim. Maintain control as near neutral as possible to avoid overcontrolling. Do not use sudden or extreme control inputs. Extreme gusts will cause large attitude changes, but smooth and moderate use of the horizontal tail will reestablish the desired attitude.
3. Altitude — Severe vertical gusts may cause appreciable altitude variations. Allow altitude to vary. Sacrifice altitude to maintain attitude. Do not chase altitude and vertical velocity indications.

PENETRATION SPEED

If flight thru turbulent air is unavoidable, the recommended "best penetration speed" is *300* KIAS.

WARNING

Flying in turbulence or hail may result in engine inlet duct airflow distortion. This distortion can result in engine surge and possible flameout.

COLD WEATHER OPERATION

WARNING

When the cockpit is cold-soaked below −20° F for extended periods, probability of proper operation of the M-38 rocket is reduced. Parking aircraft in heated hangar or preheating cockpit is mandatory.

Most cold weather operation difficulties are encountered on the ground. The following instructions are to be used with the normal procedures in section II when cold weather aircraft operation is necessary.

BEFORE ENTERING AIRCRAFT

Remove protective covers and duct plugs; check to see that surfaces, ducts, struts, drains, and vents are free of snow, ice, and frost. Brush off light snow and frost. Remove ice and encrusted snow, either by a direct flow of air from a portable ground heater or by using deicing fluid. Remove light frost from the windshield and canopy with a clean soft rag.

WARNING

- Takeoff distance and climb performance can be seriously degraded by snow and ice accumulation. The roughness and distribution of the ice and snow can vary stall speeds and characteristics dangerously. Loss of an engine on takeoff is serious enough without the added and avoidable hazard of ice and snow on the aircraft. Ice and snow must be removed before flight is attempted.
- Ensure that water does not accumulate in control hinge areas or other critical areas where refreezing may cause damage or binding.

CAUTION

To avoid damage to aircraft surfaces, do not permit ice to be chipped or scraped away.

Check the fuel system vents on the vertical stabilizer for freedom from ice. Inspect aircraft carefully for fuel and hydraulic leaks caused by contraction of fittings or by shrinkage of packings.

Inspect area behind aircraft to ensure that water or snow will not be blown onto personnel and equipment during engine start.

ENTERING AIRCRAFT

While wearing bulky arctic clothing, strapping-in may be difficult. Entering the cockpit with parachute on is easier than trying to slip into the parachute harness after it has been attached to the survival kit in the cockpit. The survival kit straps should be let out fully before entering the cockpit. The crew chief's assistance will be required to fasten these straps to the parachute harness.

WARNING

- ntry into the cockpit using the pullout builtin steps will be difficult when wearing cold weather flying gear. Use extreme caution while entering.
- Keep oxygen mask well clear of face until after engine start and cockpit warms. Even so, the exhalation valve may have frozen and could require forceful warm breath to free the stuck valve.

ENGINE START

Use external power for starting to conserve the battery. No preheat or special starting procedures are required. Turn on cockpit heat and canopy defog system, as required, immediately after engine start. Use the following engine start procedure only when starting difficulties are encountered during cold weather:

1. Throttle — Advance to IDLE.
2. External Air — Apply.
3. Start Button (at first indication of RPM) — PUSH.

WARMUP AND GROUND CHECK

After engine start, oil pressure indications above 55 psi will be observed. As the oil warms up, pressure should reduce to within operating limits. If oil pressure does not return to operating limits within 6 minutes after engine start, the engine should be shut down. Slightly lower idle speeds are to be expected with cold engines and a small advance of throttles may be necessary to place the generators on the line. When engines are sufficiently warmed up, check flight controls, speed brake, and aileron trim for proper operation. Cycle flight controls 4 to 6 times. Check hydraulic pressure, control reaction, and operation of all instruments.

TAXIING

Nosewheel steering effectiveness is reduced when taxiing on ice and hard packed snow. A combination of nosewheel steering and wheel braking should be used for directional control. The nosewheel will skid sideways easily, increasing the possibility of tire damage. To ensure positive engagement of nosewheel steering, depress control button firmly when wearing heavy flying gloves. It is suggested that alternate fingers be used for this function since constant pressure with one could lead to frostbite. If conditions permit, taxi with one engine at idle and the other at high rpm (70% to 80%) to provide more heat for the cockpit and for canopy and windshield defrosting. However, reduced speeds will generally be necessary when taxiing over the uneven snow and ice covered surfaces common in low temperature environments. Increase the normal interval between aircraft, both to ensure a safe stopping distance and to prevent icing of aircraft surfaces from melted snow and ice caused by the jet blast of the preceding aircraft. Minimize taxi time to conserve fuel and reduce the amount of ice fog generated by the engines. If bare spots exist thru the snow, skidding onto them should be avoided.

WARNING

Make sure all instruments have warmed up sufficiently to ensure normal operation. Check for sluggish instruments while taxiing.

TAKEOFF

Due to increased thrust available at low ambient temperatures on icy or wet runways, the aircraft may skid during MIL power runup even though the brakes are locked. It may be necessary to run up one engine at a time and start the takeoff roll at less than MIL power.

SCRAMBLE TAKEOFF

When the temperature is 32°F or below and operational requirements dictate, it is permissible to take off when a decreasing indication in oil pressure has been established and pressure indications have decreased to 95 psi or below. If operating at military power or in afterburner, the oil pressure should decrease to normal operating limits within approximately 6 minutes. If the pressure does not return to normal within the time limit, the throttle should be retarded as required to decrease the pressure to an acceptable limit. If lowering the power setting does not decrease the oil pressure within limits, shut down engine.

LANDING

Use minimum run landing techniques. When landing on runways that have patches of dry surface, avoid locking the wheels. If the aircraft starts to skid, release brakes until recovery from skid is accomplished.

CAUTION

After touchdown and deployment of drag chute, prepare for tendency of the aircraft to veer toward either side of runway. In cold environment, main landing gear struts may not compress equal amounts, causing aircraft to track to side of lower strut. Nosewheel steering will be ineffective during high-speed portion of landing roll on icy runway.

ENGINE SHUTDOWN

Use normal engine shutdown procedure.

BEFORE LEAVING AIRCRAFT

The canopy should be fully closed on aircraft parked outdoors to prevent the entry of blowing snow caused by operation of other aircraft or from natural conditions.

HOT WEATHER AND DESERT OPERATION

Operation in hot weather and desert requires that precautions be taken to protect the aircraft from damage caused by high temperatures, dust, and sand. Care must be taken to prevent the entrance of sand into aircraft parts and systems such as the engines, fuel system, pitot-static system, etc. All filters should be checked more frequently than under normal conditions. Plastic and rubber segments of the aircraft should be protected both from high temperatures and from blowing sand. Canopy covers should be left off to prevent sand from accumulating between the cover and the canopy and acting as an abrasive on the plastic canopy. With a canopy closed, cockpit damage may result when ambient temperature is above 110°F. Canopy should be opened in advance of flight to reduce cockpit temperature for comfort. Desert and hot weather operation requires that, in addition to normal procedures, the following precautions be observed.

ENTERING AIRCRAFT

During preflight inspection and upon entering aircraft, it is recommended that light flying gloves be worn since aircraft surfaces are extremely hot in high ambient temperatures.

AFTER ENGINE START

To prevent formation of frost and fog after engines have been started and canopy has been closed in high humidity conditions, operate the canopy defog system at highest flow possible and set cockpit temperature as high as possible (consistent with pilot's comfort).

TAKEOFF

1. Use normal takeoff technique.
2. Be alert for gusts and wind shifts near the ground.

NOTE

Hot weather takeoff with high gross weights will result in excessive differences between normal takeoff speed and single-engine takeoff speed.

INFLIGHT

The canopy defog system should be operated at the highest flow possible and set cockpit temperature as high as possible (consistent with pilot's comfort) for 10 minutes prior to descent from high altitude flight to provide an airflow over the transparent surfaces and prevent the formation of frost or fog during descent.

APPROACH AND LANDING

1. Monitor airspeed closely to ensure that recommended approach and touchdown airspeeds are maintained; high ambient temperatures cause speed relative to the ground to be higher than normal.
2. Anticipate a long landing roll due to higher ground speed at touchdown.

APPENDIX I

PERFORMANCE DATA

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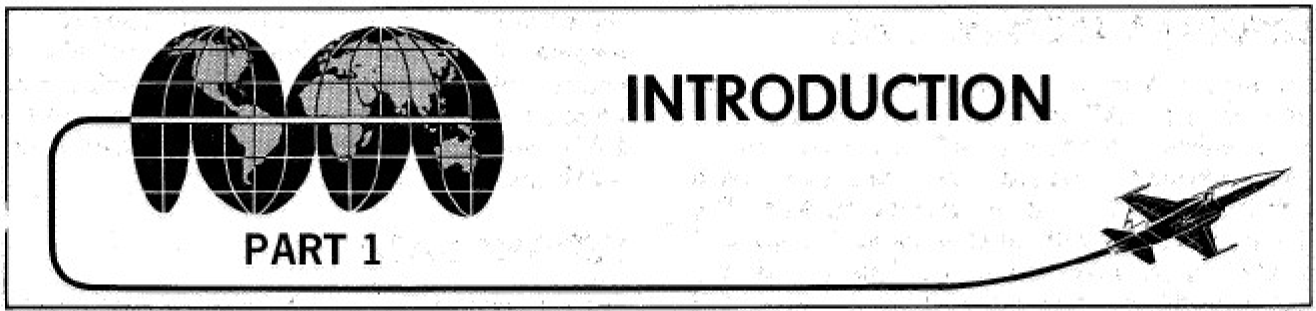

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Page numbers underlined denote charts.

INTRODUCTION

The appendix contains the performance data required for planning missions. Data are divided into parts 1 thru 10 in sequence for mission planning. Part 9 contains data for Dart target tow missions. Part 10 details the mission planning process. Each part explains the use of the charts. The charts are in graph form, using drag index to identify store loadings. Single-engine performance is shown for a drag index range of 0 to 120.

NOTE

Where performance differences require, charts are provided for both Ⓔ and Ⓕ aircraft. However, all sample problems are based on the Ⓔ. Computations pertinent to the Ⓕ may be made by using the sample problem procedures and inserting data derived from the Ⓕ performance charts.

PERFORMANCE DATA BASIS

Performance data are based on flight test and estimated data. All altitudes are mean sea level (MSL) unless otherwise noted. Airspeeds are in knots indicated airspeed and indicated mach number to provide a direct cockpit readout. The differences between calibrated airspeed (KCAS) and indicated airspeed (KIAS) are negligible, as are the differences between true mach number (TMN) and indicated mach number (IMN). Charts are for US standard atmosphere conditions. Ambient temperature corrections are provided where temperature effects are significant. Weights are based on JP-4 fuel at 6.5 pounds per US gallon. Engine fuel consumption rates are increased 5% to account for variations in service aircraft. Parts 2 and 7 correct the data for the effect of cg position. Each chart contains a miniature guide box in the upper right corner with "chase-thru" guidelines for reference. All performance charts are based on JP-4 fuel.

NOTE

Performance charts are applicable for use with alternate fuel at 6.7 pounds per US gallon.

DRAG INDEX SYSTEM

The drag index system presents performance for a number of store loadings on one chart. Drag numbers are given for the basic aircraft, accessory equipment, wing-tip stores, centerline stores, and wing stores. Stores are assigned a drag number depending on size, shape, and location on the aircraft. The sum of the drag numbers is the drag index. Drag index determines the aircraft performance for the configuration. In the performance charts, the drag index is, at times, not in numerical order with respect to the other drag indexes on the same chart due to the effect of wingtip stores on drag due to lift. Performance should be interpolated in the charts for intermediate values of drag index unless otherwise stated.

DRAG NUMBER CHART

Drag numbers are in FA1-1. Note that the drag numbers for wing stores depend on the type of stores on the adjacent pylons. Drag numbers at the intersection of the outboard and inboard wing stations represent the total of the combination of these stations and are based on symmetrical store loading. When store loading changes, as when the empty tank is dropped or rockets are fired, the drag numbers of the remaining items must be read from FA1-1 and recalculated to determine the drag index for the new store configuration.

WEIGHT DATA

Weight data in FA1-2 provides average aircraft-gross weight and weights of fuel, tank, ammunition, pylons, accessories, stores, and training equipment. The gross weight listed is the weight of a typical aircraft. See T.O. 1-1B-40 for actual gross weight. Trapped fuel is included in the external tank weight.

USE OF DRAG NUMBER AND WEIGHT DATA CHARTS

Use of FA1-1 and FA1-2 to determine drag indexes and store weights during a mission is shown below. Assume an F-5E with a 275-gallon fuel tank on the centerline, an MK-82 (LD) bomb on each inboard and outboard wing station, and an AIM-9J missile on each wingtip. Determine drag index and store weights for takeoff.

	Drag No.	*Weight (Lb)*
Basic aircraft Ⓔ	2	—
Stores:		
Centerline fuel tank and pylon	32	2174
Inboard MK-82(LD) bombs and outboard MK-82(LD) bombs with pylons	70	2624
AIM-9J missiles	16	340
Drag index and total store weight	120	5138

As the mission is flown and stores are expended, the drag index of the aircraft and the store weights will change. Referring again to FA1-1 and FA1-2, the following is determined:

1. After the outboard, inboard MK-82s and centerline tank are dropped:

	Drag No.	*Weight (Lb)*
Basic aircraft Ⓔ	2	—
Stores:		
Centerline pylon	14	170
Inboard and outboard pylons	53	500
AIM-9J missiles	16	340
Drag index and total store weight	85	1010

2. After AIM-9J missiles are fired:

	Drag No.	*Weight (Lb)*
Basic aircraft Ⓔ	2	—
Stores:		
Centerline pylon	14	170
Inboard and outboard pylons	53	500
Wingtip launchers	1	—
Drag index and total store weight	70	670

AIRCRAFT TAKEOFF GROSS WEIGHT AND CG POSITION (APPROXIMATE) CHART

The Aircraft Takeoff Gross Weight and CG Position Charts for no ballast and with ballast (FA1-3, sheets 1, 2 and 3) determine the *approximate* takeoff and cg position as affected by pylons, stores, wingtip missiles, and ammunition. Sheet 1, which is used for unmodified Ⓔ aircraft [Before T.O. 1F-5E-594], does not provide an inboard pylon fuel tank correction grid but does require peculiar ammunition loading and firing restrictions to compensate for carriage of inboard pylon fuel tanks (see section V). Sheet 2 provides an additional correction grid for installation of variable ballast in the nose section of modified Ⓔ aircraft [T.O. 1F-5E-594] to compensate for carriage of inboard pylon 150-gallon or 275-gallon fuel tanks. Sheet 3 provides similar data for the Ⓕ, including correction grids for variable external tail ballast and the weight and moment of the additional pilot.

NOTE

- Cumulative external store and pylon weights exceeding the chart fan grid requires reference to T.O. 1-1B-40 for cg position calculation. (Approximation calculations are inaccurate beyond provided grid.)
- Refer to T.O. 1-1B-40 for actual aircraft takeoff weight and cg data.

USE

The charts are entered at the index point representing the aircraft average gross weight with pilot, full internal fuel and oil, and launcher rails. Each chart is divided into grids for various store loading combinations that require corrections to ascertain the particular configuration cg position. Grid A in each chart provides a cg position plot for cumulative weight of the outboard, inboard, and centerline pylons, in that order. The remaining grids of each chart provide correction factors to the cg position for wingtip missiles, ammunition, and ballast.

SAMPLE PROBLEM

NOTE

The weight of the aircraft, stores, and equipment in the examples are not actual weights. They are used for sample problem purposes only.

Given:

A. Ⓔ Average gross weight [T.O. 1F-5E-594] with launcher rails, internal fuel, oil, and pilot is 15,050 lb.
B. Weight of outboard pylon plus MK-82 LD bomb is 659 lb. Total weight of both outboard wing stations equals 1318 lb.
C. Weight of inboard pylon plus MK-82 GP bomb is 653 lb. Total weight of both inboard wing stations equals 1306 lb.
D. Weight of centerline pylon plus full 275-gallon tank is 2174 lb.
E. Weight of two AIM-9J missiles is 340 lb.
F. Weight of a full load of 20mm ammunition is 394 lb.

Calculate:

A. Approximate takeoff cg position.
B. Use Aircraft Takeoff Gross Weight and CG Position chart FA1-3, sheet 2.

① From the Index Point (15,050 lb) marked ⊗ on Grid A, proceed right along the line marked OUTBD until a weight value of 1318 lb is obtained from scale at top of chart (intersected by vertical guidelines).

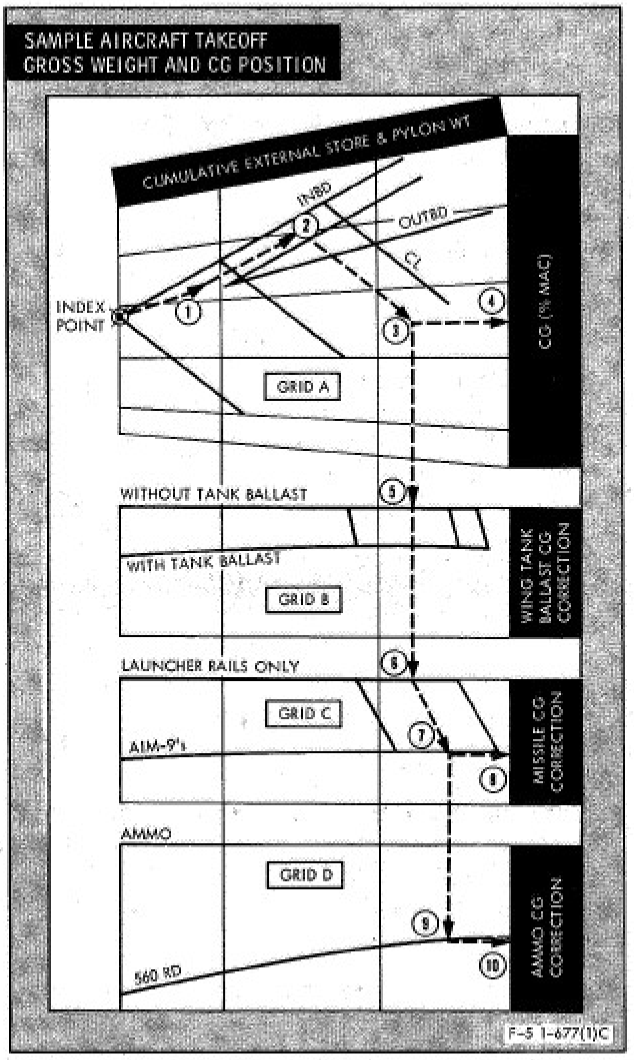
NOTE

If pylons are not installed, cg position is read to the right by paralleling the unmarked chart grid lines.

② From point ① continue right paralleling the nearest INBD line until a cumulative total external store and pylon weight of 2624 lb is obtained (1318 lb + 1306 lb).

③ From point ② project a line downward parallel to the nearest CL line until a cumulative total external store and pylon weight of 4798 lb is obtained (1318 lb + 1306 lb + 2174 lb).

④ Following guidelines to the right from point ③ (which is the approximate takeoff cg of the aircraft *without* ammunition or missiles), read cg of 16.0% MAC and gross weight of 19,848 lb (15,050 lb + 4798 lb).



⑤ Return to point ③ and proceed down, following the nearest vertical guideline to Grid B w/o inbd fuel tanks ballast curve. Since wing fuel tanks are not carried, no correction is required for additional ballast.

⑥ From point ⑤ proceed down, following the nearest guideline to Grid C Launcher Rails Only curve. The launcher rails configuration does not require correction factors for cg position or gross weight (data basis for Index Point).

⑦ From point ⑥ contour guidelines to the AIM-9 missile curve. Note added weight of 342 lb for AIM-9 missiles (340 lb for AIM-9J, see FA1-2).

⑧ Proceed right and read CG correction factor of +0.5% MAC for missile configuration.

⑨ Return to point ⑦ and proceed down following the nearest guideline to Grid D Ammunition — 560 rounds curve. Note added weight of 394 lb for full load of 20mm ammunition.

⑩ Proceed right and read CG correction factor of -4% MAC for ammunition.

Thus: Takeoff Gross Wt (19,848 + 340 lb + 394 lb) = 20,582 lb
Takeoff CG Position (16% + 0.5% − 4.0%) = 12.5% MAC

ALTIMETER AND AIRSPEED INSTALLATION ERROR CORRECTIONS

Altimeter and airspeed installation error corrections are presented in FA1-4. These corrections are valid for flaps and gear up or down and for all store configurations. Enter charts with KCAS and true pressure altitude and read corrections to altitude in feet in upper chart and to airspeed in lower chart. To obtain indicated pressure altitude, add altimeter installation error correction to true pressure altitude. KIAS is obtained by adding airspeed installation error correction to KCAS.

MACH NUMBER INSTALLATION ERROR CORRECTION

Indicated mach number may be read as true mach number. Installation error is negligible; therefore, a chart for correction is not required.

COMPRESSIBILITY CORRECTION TO CALIBRATED AIRSPEED

The difference between KCAS and KEAS is the compressibility correction shown in FA1-5 (KEAS = KCAS − airspeed compressibility correction).

AIRSPEED CONVERSION

Chart FA1-6 converts between KCAS, true mach number, and true airspeed. Enter the chart with KCAS and move upward to the pressure altitude. Read true mach number on the left scale and true airspeed for standard atmosphere between the sloping speed lines whose scale is at the sea level pressure altitude line. To correct true airspeed for off-standard temperatures, move horizontally from the intersection of KCAS and pressure altitude to the sea level pressure altitude line, then down to the ambient temperature and read the corrected true airspeed on the scale at the right.

STANDARD ATMOSPHERE TABLE

US standard atmosphere is tabulated at 1000-foot increments between −2000 and 65,000 feet altitude in FA1-7. Sea level values are listed in the top of the chart for use with the ratios shown in the table. As an example of the use of the chart, find the equivalent airspeed in knots in standard atmosphere corresponding to 0.85 mach number at 30,000 feet pressure altitude. In FA1-7 at 30,000 feet read $a/a_o = 0.8909$, read $1/\sqrt{\sigma} = 1.6349$, and at the top of the chart read $a_o = 661.47$ knots

Then: $a = a_o \times a/a_o = 661.47 \times 0.8909$
$= 589.3$ knots.

KTAS = mach X a = 0.85 X 589.3
= 500.9 knots.

KEAS = KTAS $\div 1/\sqrt{\sigma}$ = 500.9 ÷ 1.6349
= 306.4 knots.

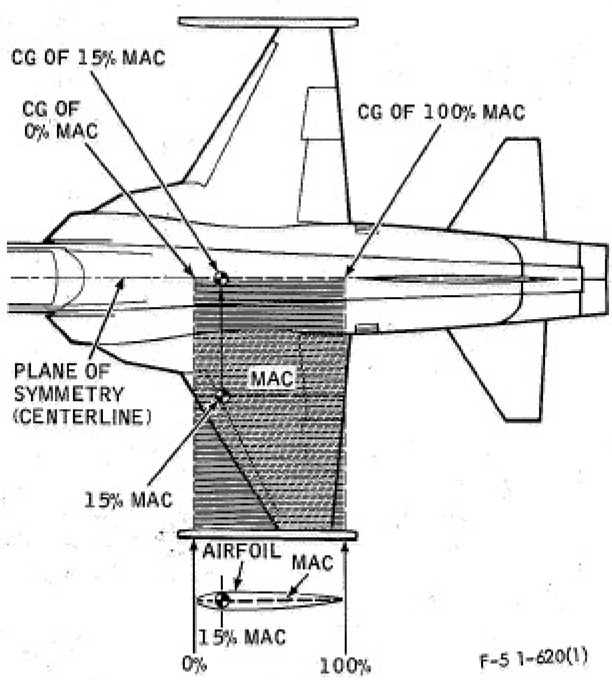
STANDARD UNITS CONVERSION

Linear scales for converting units of temperature, distance, and speed from one measurement system to another are provided in FA1-8. Additional conversion factors for volume, pressure, and weight are listed at the bottom of the chart.

MEAN AERODYNAMIC CHORD

The mean aerodynamic chord (MAC) is the chord of an imaginary rectangular wing which has force vectors identical with those of the actual wing. This chord is used as a reference for the forces and moments acting on the aircraft. The following illustration depicts the location of the MAC on the aircraft. The aircraft center-of-gravity position is a point on the plane of symmetry (centerline) behind the leading edge of the MAC equal to a percentage of the length of the MAC. The illustration shows a cg position of 15% MAC.

MEAN AERODYNAMIC CHORD



RUNWAY WIND COMPONENTS

The runway wind components chart of FA1-9 converts surface wind velocities into components parallel to and across the runway. The headwind or tailwind component is used to compute takeoff and landing distances, and the crosswind component is used to determine the feasibility of operations.

DRAG NUMBERS

WINGTIP STATIONS ❶	
(2) LAUNCHER RAILS (ONLY)	1
(2) AIM-9B (OR CAPTIVE)	18
(2) AIM-9E, -9J, -9J-1 (OR CAPTIVE)	16
LEFT LAUNCHER RAIL WITH AFT FAIRING REMOVED + RIGHT LAUNCHER RAIL	3
(1) AIM-9B (OR CAPTIVE)+(1) LAUNCHER RAIL	10
(1) AIM-9E, -9J, -9J-1 (OR CAPTIVE) + (1) LAUNCHER RAIL	9
TDU-11/B + AIM-9	19
TDU-11/B + LAUNCHER RAILS	12

BASIC AIRCRAFT	Ⓔ	Ⓕ
W/O TIP LAUNCHER RAILS	2	8
E-4 WITH RECON NOSE	6	–

Code

❶ WINGTIP STORE DRAG NUMBER INCLUDES TIP LAUNCHER RAIL.

❷ PYLON STORE DRAG NUMBER INCLUDES PYLON.

❸ DRAG NUMBER WITH J-HOOKS INSTALLED OR AFTER PYLON JETTISON:

CL	1	(2) INBD	2	(2) OUTBD	2

(U) UNFINNED (F) FINNED (W/O) WITHOUT

CENTERLINE STATION ❷			Ⓔ	Ⓕ
NO PYLON ❸			0	
PYLON			14	
150-GALLON FUEL TANK			22	
WRM 150-GALLON FUEL TANK			25	
275-GALLON FUEL TANK			32	
M129E2			28	
BLU-1/B, B/B, C/B; -27/B, A/B, B/B, C/B		U	22	
		F	27	
BLU-32A/B, B/B, C/B		U	20	
		F	24	
CBU-24B/B; -49B/B; -52B/B; -58/B; -71/B			23	
MK-36			21	
MK-82 LD			17	
MK-82 SE			21	
BRU-27/A MER	5 MK-82 LD OR SE		88	
	4 MK-82 LD OR SE		65	
	3 MK-82 LD OR SE		61	
	2 MK-82 LD OR SE		57	
	EMPTY		44	
MK-84 LD			25	Ⓕ*
SUU-20/A(M) OR -20A/A	LOADED (BDU-33 SERIES)		51	58
	LOADED (MK-106)		53	60
	EMPTY		39	46
SUU-20B/A	LOADED (BDU-33 SERIES)		49	56
	LOADED (MK-106)		51	58
	EMPTY		37	44

* INCLUDES DISPENSER ADAPTER ASSEMBLY.

OUTBOARD STATIONS ❷ \ INBOARD STATIONS ❷	NO PYLON ❸	PYLON	150-GALLON FUEL TANK	WRM 150-GALLON FUEL TANK	275-GALLON FUEL TANK	MK-82 LD	MK-82 SE	GBU-12/B, A/B (LGB-HS)	MK-36	M129E2	CBU-24B/B; -49B/B; -52B/B; -58/B; -71/B	BLU-1/B, B/B, C/B; -27/B, A/B, B/B, C/B (Ⓔ ONLY) U	BLU-1/B, B/B, C/B; -27/B, A/B, B/B, C/B (Ⓔ ONLY) F	BLU-32A/B, B/B, C/B U	BLU-32A/B, B/B, C/B F	LAU-3/A, A/A, B/A; -60/A NOSE CONE ONLY	LAU-3/A, A/A, B/A; -60/A NOSE AND TAIL CONE	LAU-3/A, A/A, B/A; -60/A W/O EITHER CONE (UNFIRED)	LAU-3/A, A/A, B/A; -60/A W/O EITHER CONE (FIRED)	LAU-68A/A, B/A UNFIRED	LAU-68A/A, B/A FIRED
NO PYLON ❸	0	27	48	54	70	33	43	48	43	58	64	44	54	39	47	56	38	147	94	29	46
PYLON	27	53	74	80	97	60	70	75	70	85	91	71	81	65	73	83	65	174	121	56	73
MK-82 LD	34	61	86	92	109	70															
MK-82 SE	44	71	96	102	119		90														
MK-36	44	71	96	102	119				90												
M129E2	59	86								128											
CBU-24B/B; -49B/B; -52B/B; -58/B; -71/B	56	83									131										
BLU-1/B, B/B, C/B; -27/B, A/B, B/B, C/B U	46	72	118	124	142							111									
BLU-1/B, B/B, C/B; -27/B, A/B, B/B, C/B F	55	82	128	134	151								130								
BLU-32A/B, B/B, C/B U	40	67												89							
BLU-32A/B, B/B, C/B F	48	75													105						
LAU-3/A, A/A, B/A; -60/A NOSE CONE ONLY	57	84	122	128	147											123					
LAU-3/A, A/A, B/A; -60/A NOSE AND TAIL CONE	39	66	104	110	129												87				
LAU-3/A, A/A, B/A; -60/A W/O EITHER CONE (UNFIRED)	148	175	213	219	238													305			
LAU-3/A, A/A, B/A; -60/A W/O EITHER CONE (FIRED)	95	122	160	166	185														199		
LAU-68A/A, B/A UNFIRED	30	57																		62	
LAU-68A/A, B/A FIRED	47	74																			96
SUU-25A/A	121	148																			
SUU-25C/A, E/A	76	103																			
GBU-12/B, A/B (LGB-HS)	51	78	103	109	126			105													
GBU-12A/B (LGB-LS)	57	84	111	117	134																

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FA1-1.

WEIGHT DATA

AIRCRAFT — AVERAGE GROSS WEIGHT

WITH WINGTIP LAUNCHER RAILS:	JP-4	JET A-1 OR JP-8
(E) W/O BALLAST	14,950 LB	15,090 LB
(E) W/BALLAST [T.O. 1F-5E-594]	15,050 LB	15,190 LB
(F) W/O VARIABLE TAIL BALLAST	15,510 LB	15,650 LB
(F) W/VARIABLE TAIL BALLAST	15,650 LB	15,790 LB

Note

- AIRCRAFT AVERAGE GROSS WEIGHT INCLUDES PILOT WITH PARACHUTE AND FLIGHT GEAR (240 LB) (ONE CREW ONLY (F)), AND FULL INTERNAL FUEL AND OIL (NO AMMO.)
- REFER TO T.O. 1-1B-40 FOR INDIVIDUAL AIRCRAFT WEIGHT.

AMMO

	WT — LB
(E) (560) ROUNDS 20MM (FULL LOAD)	394
(F) (140) ROUNDS 20MM (FULL LOAD)	98
(1) ROUND 20MM	0.7

ACCESSORIES

PYLONS:		WT — LB
(1) CL		170
(1) INBD		122
(1) OUTBD		128
LAUNCHERS:		
(1) LAU-3/A, -3A/A, -3B/A, OR -60/A	EMPTY	74
	FULL	469 *
(1) LAU-68A/A, B/A	EMPTY	71
	FULL	215 *

*MAY VARY WITH TYPE WARHEADS LOADED.

BOMB RACK:		
(1) BRU-27/A MER		200
DISPENSERS:		
(1) SUU-20/A (M) (EMPTY)		320
(1) SUU-20A/A (EMPTY)		325
(1) SUU-20B/A (EMPTY)		270
(F) SUU-20 PYLON ADAPTER		47
(1) SUU-25A/A	EMPTY	160
	FULL	400 **
(1) SUU-25C/A, E/A	EMPTY	262
	FULL	497 **

**MAY VARY WITH TYPE FLARE/MARKERS LOADED.

TOW TARGET EQUIPMENT

	WT — LB
(1) RMU-10/A TOW REEL POD (INCLUDES 2300 FT OF 11/64 TOW CABLE)	475
(1) TARGET CARRIER ASSEMBLY	270
(1) TDU-10/B DART TARGET	197

TANKS AND FUEL

	EMPTY TANK WT — LB	USABLE FUEL WT — LB	TOTAL WT — LB
INTERNAL FUEL	—	4400 (4536)	4400 (4536)
(1) CL PYLON TANK — 275-GAL	229	1775 (1829)	2004 (2058)
(2) INBD PYLON TANKS — 275-GAL	454	3549 (3658)	4004 (4112)
(1) CL PYLON TANK — 150-GAL	148	975 (1005)	1123 (1153)
(2) INBD PYLON TANKS — 150-GAL	306	1950 (2010)	2256 (2316)

Note

- JET A-1 OR JP-8 FUEL WEIGHT IN PARENS ( ).
- EMPTY PYLON TANK WEIGHT INCLUDES UNUSABLE FUEL: 275-GAL TANK 10 LB; 150-GAL TANK 13 LB (EITHER FUEL).
- SARGENT-FLETCHER 275-GAL INBD TANKS — REDUCE FUEL QUANTITIES: 169 LB/JP-4, 174 LB/JET A-1 OR JP-8.
- (E) TANK VARIABLE BALLAST OF 80 LB REQUIRED FOR INBD TANKS.

MISSILES, ROCKETS, BOMBS AND FLARES

MISSILES:		WT — LB
(1) AIM-9B		165
(1) AIM-9E		171
(1) AIM-9J		170
(1) AIM-9J-1		166
ROCKETS:		
(1) 2.75-INCH FFAR	MK1 WARHEAD	18
	M151 WARHEAD	21
	M156 WARHEAD	21
	WDU-4 WARHEAD	21
(1) TDU-11/B TARGET ROCKET		215
BOMBS:		
(1) MK-82 LD		531
(1) MK-82 SE		570
(1) MK-84 LD		1970
(1) GBU-12/B, A/B (LGB-HS)		605
(1) GBU-12A/B (LGB-LS)		619
(1) M129E2 LEAFLET		203
(1) MK-36 DESTRUCTOR		572
(1) CBU-24B/B OR -49B/B		822
(1) CBU-52B/B		785
(1) CBU-58/B OR -71/B		818
(1) BLU-1/B, B/B, OR C/B FIRE BOMB	FINNED	717
	UNFINNED	702
(1) BLU-27/B FIRE BOMB	FINNED	854
	UNFINNED	839
(1) BLU-27A/B, B/B, OR C/B FIRE BOMB	FINNED	797
	UNFINNED	782
(1) BLU-32A/B, B/B, OR C/B FIRE BOMB	FINNED	597
	UNFINNED	582
(1) BDU-33 SERIES PRACTICE		24
(1) MK-106 PRACTICE		5
FLARES/MARKERS:		
(1) MK-24 MOD 4		27
(1) LUU-1/B OR -5/B		27
(1) LUU-2/B		30

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FA1-2.

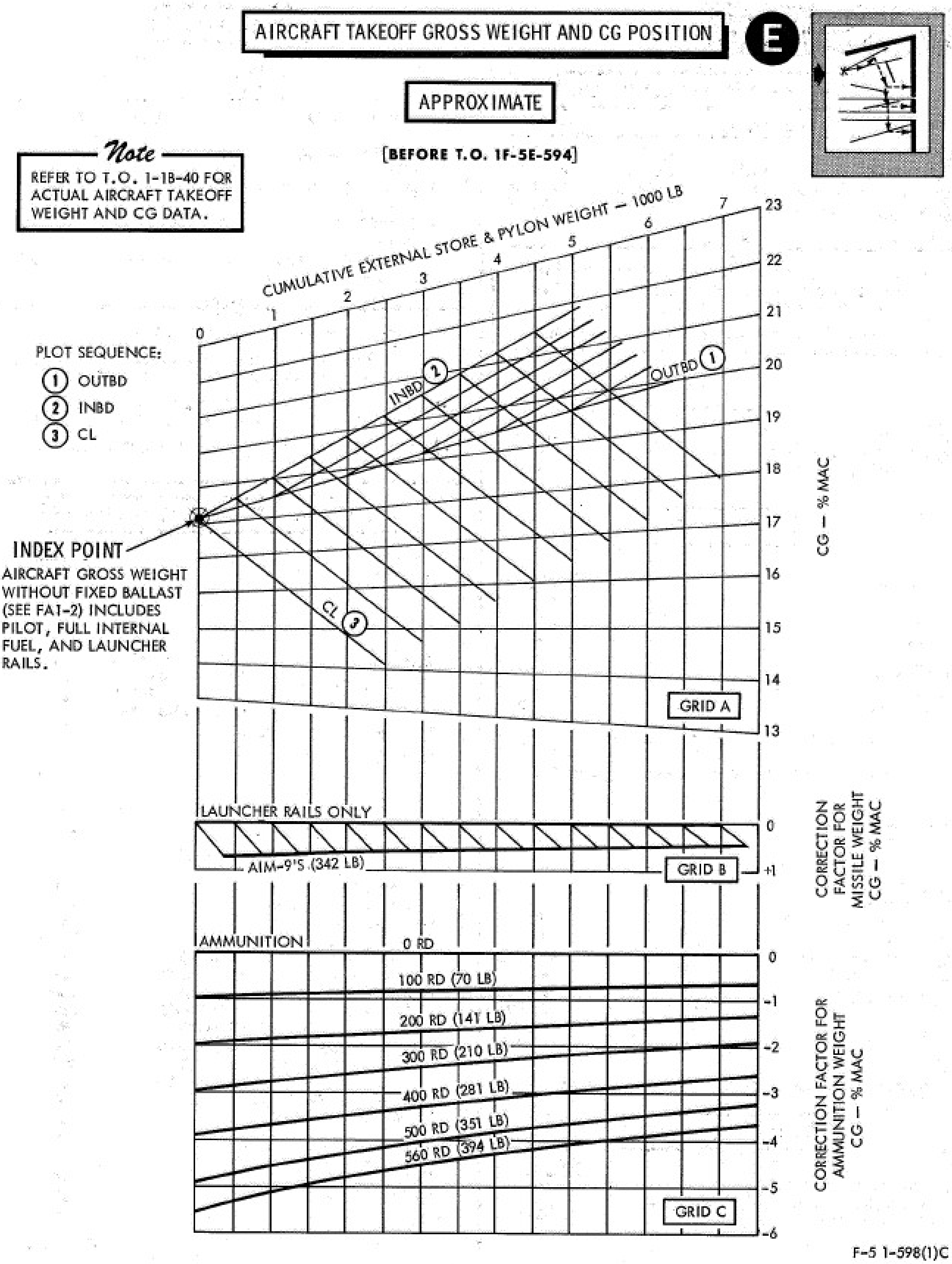
AIRCRAFT TAKEOFF GROSS WEIGHT AND CG POSITION

APPROXIMATE

[BEFORE T.O. 1F-5E-594]

Note

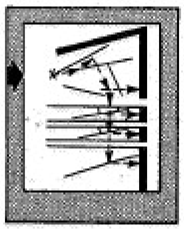
REFER TO T.O. 1-1B-40 FOR ACTUAL AIRCRAFT TAKEOFF WEIGHT AND CG DATA.



FA1-3 (Sheet 1).

AIRCRAFT TAKEOFF GROSS WEIGHT AND CG POSITION

E

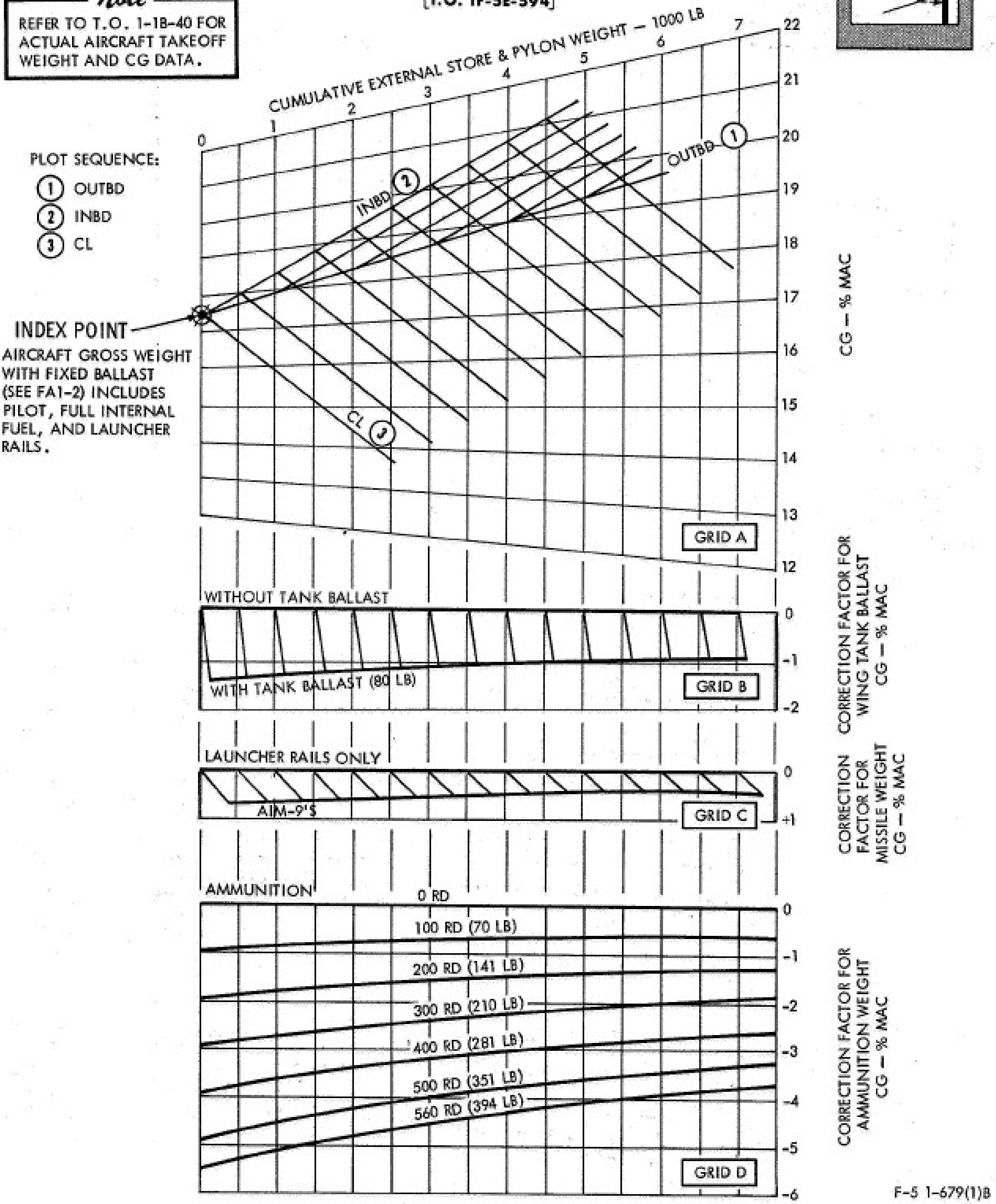


APPROXIMATE

[T.O. 1F-5E-594]

Note

REFER TO T.O. 1-1B-40 FOR ACTUAL AIRCRAFT TAKEOFF WEIGHT AND CG DATA.



FA1-3 (Sheet 2).

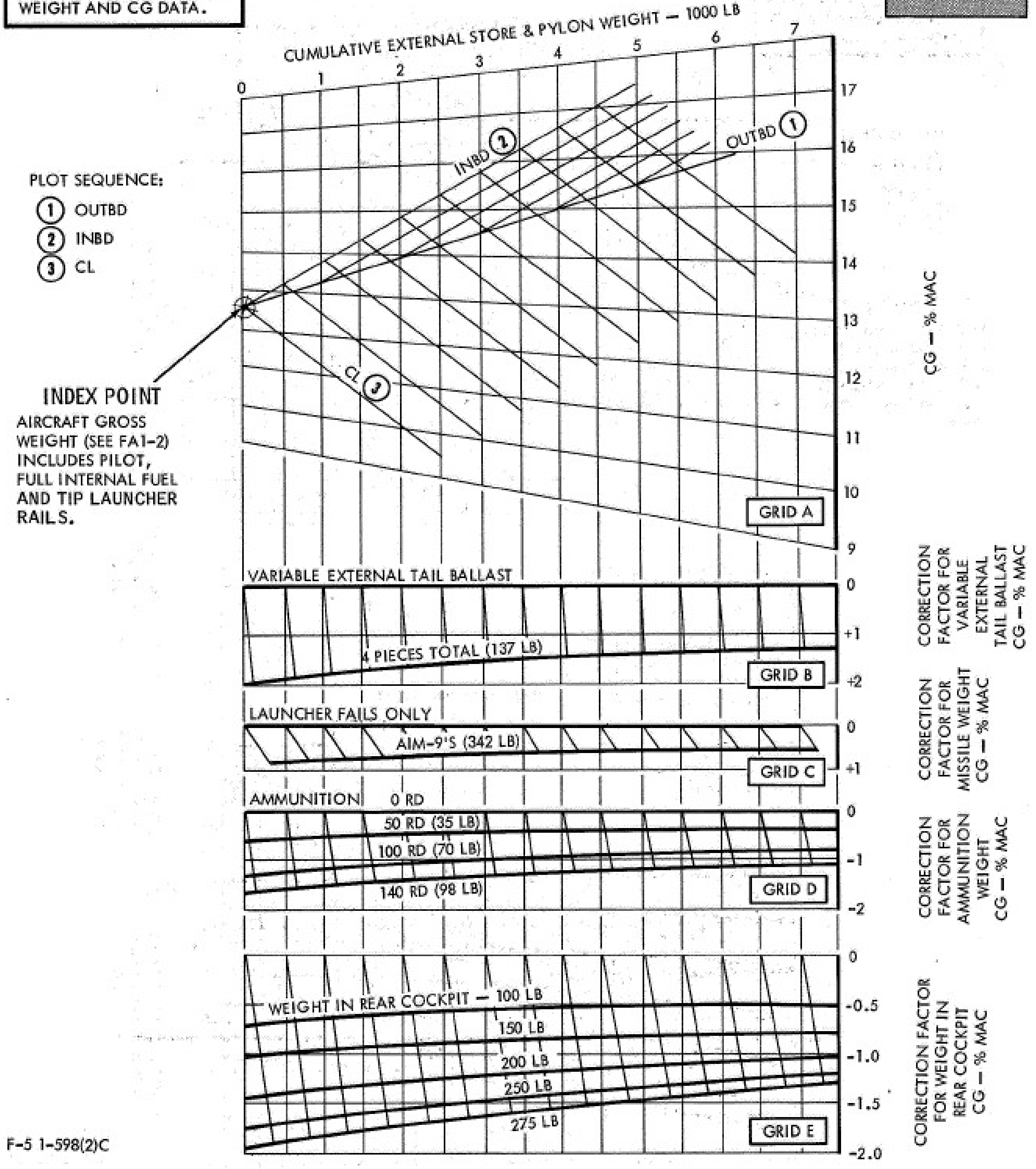
AIRCRAFT TAKEOFF GROSS WEIGHT AND CG POSITION

APPROXIMATE

F

Note

REFER TO T.O. 1-1B-40 FOR ACTUAL AIRCRAFT TAKEOFF WEIGHT AND CG DATA.



FA1-3 (Sheet 3).

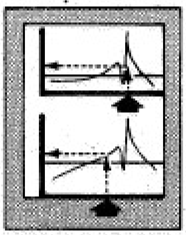
MODEL: F-5E/F
DATE: 1 DECEMBER 1977
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

ALTIMETER AND AIRSPEED INSTALLATION ERROR CORRECTION

ALL CONFIGURATIONS

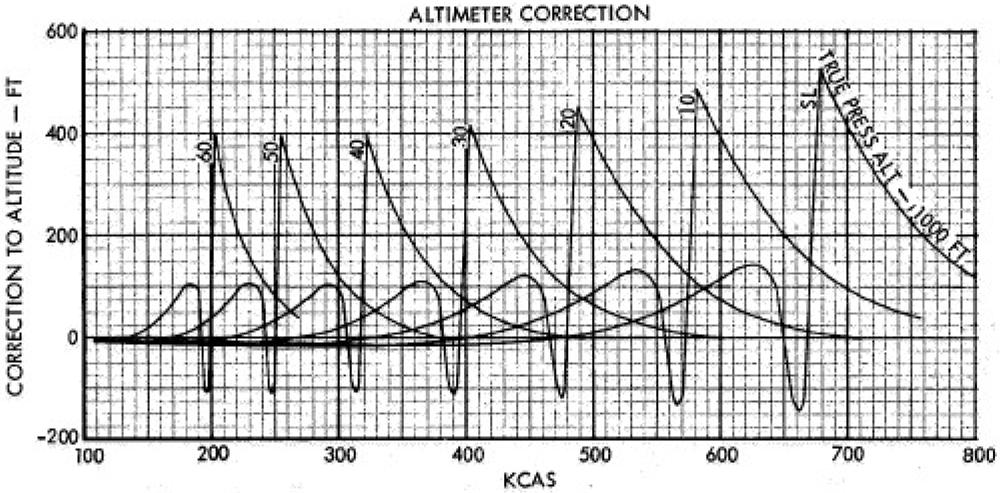
GEAR AND FLAPS UP OR DOWN



Note

- CORRECTION APPLICABLE TO AAU-7A/A, AAU-19/A IN STBY MODE ONLY, AND AAU-34/A IN PNEU MODE ONLY.
- ADD CORRECTION TO OBTAIN INDICATED PRESSURE ALTITUDE.

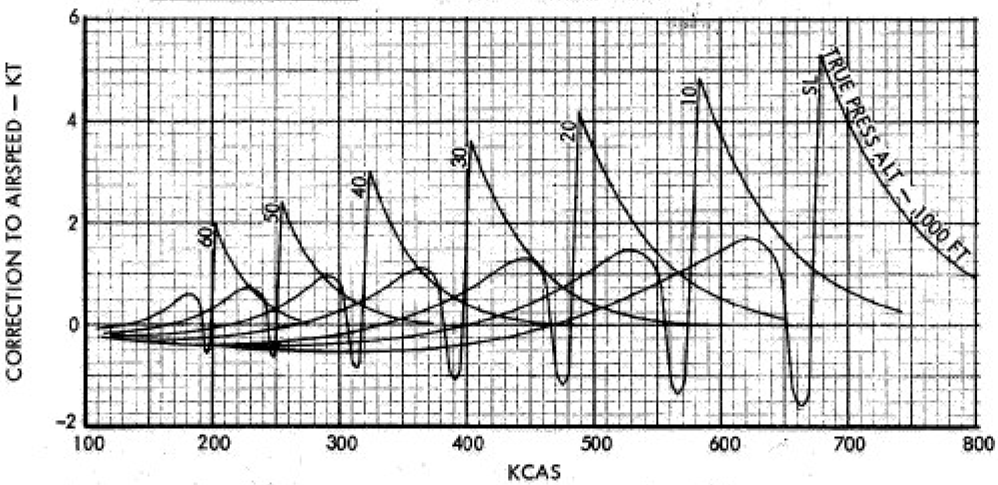
ALTIMETER CORRECTION



Note

ADD CORRECTION TO OBTAIN KIAS.

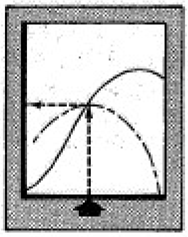
AIRSPEED CORRECTION



F-5 1-537(1)B

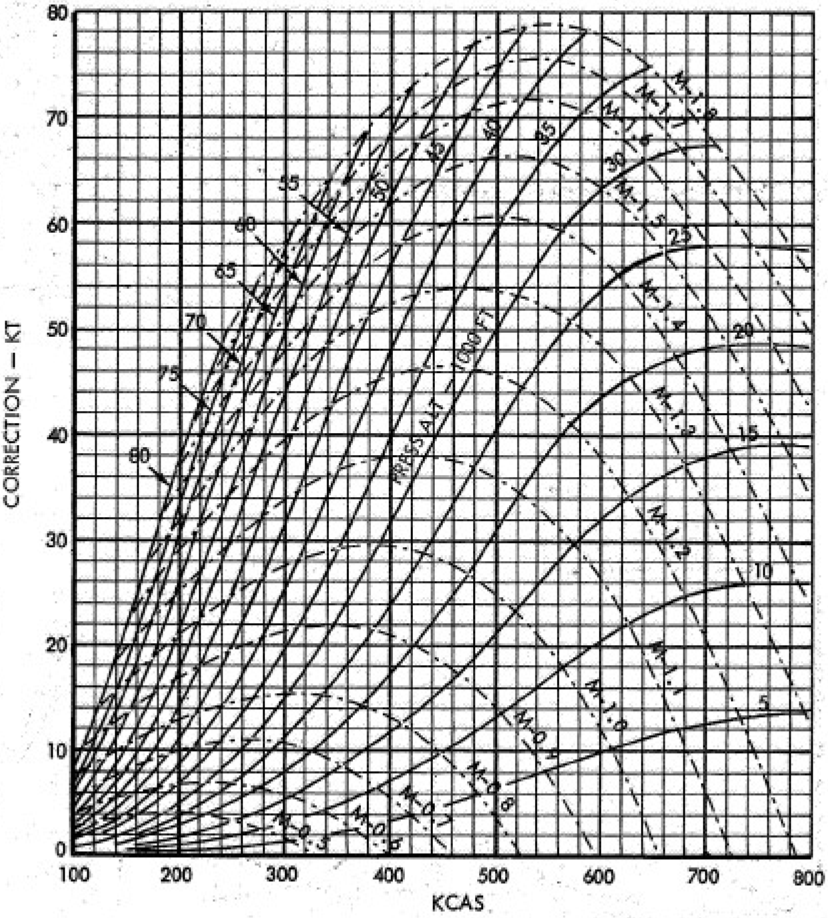
FA1-4.

COMPRESSIBILITY CORRECTION TO CALIBRATED AIRSPEED



Note

SUBTRACT COMPRESSIBILITY CORRECTION FROM KCAS TO OBTAIN KEAS.

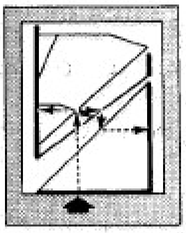


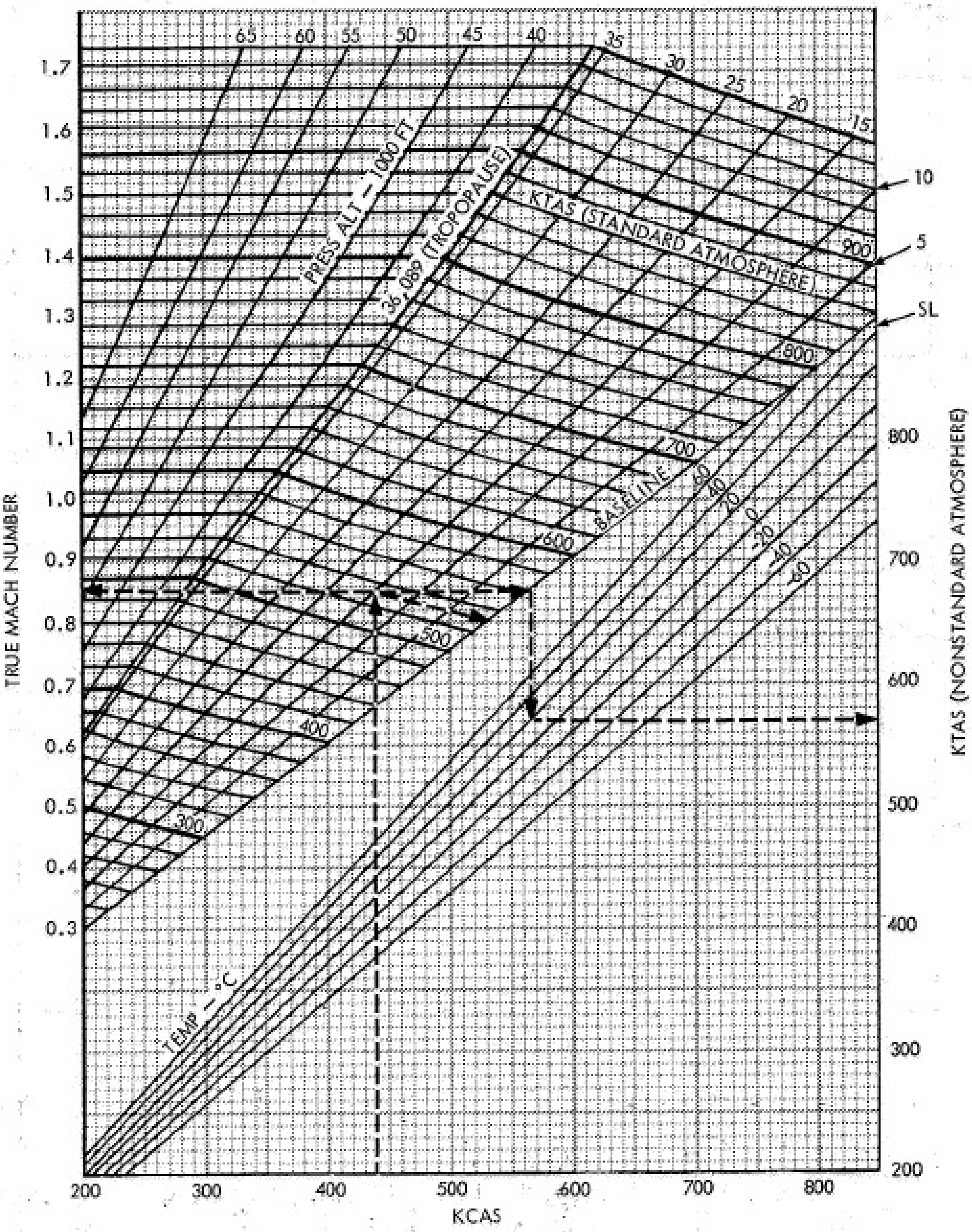
F-5E 1-443B

FA1-5.

EXAMPLE:
KCAS = 440
PRESS ALT = 15,000 FT
TMN = 0.85
KTAS (STD DAY) = 535
KTAS (AT 20°C) = 570

AIRSPEED CONVERSION





FA1-6.

STANDARD ATMOSPHERE TABLE

STANDARD SEA LEVEL AIR:
T = 59°F (15°C)
P = 29.921 IN. OF HG

W = 0.076475 LB/CU FT ρ_o = 0.0023769 SLUGS/CU FT
1 IN. OF HG = 70.732 LB/SQ FT = 0.4912 LB/SQ IN.
a_o = 1116.44 FT/SEC = 661.47 KT

U.S. STANDARD ATMOSPHERE

ALTITUDE FEET	DENSITY RATIO $\rho/\rho_o = \sigma$	$1/\sqrt{\sigma}$	TEMPERATURE		SPEED OF SOUND RATIO a/a_o	PRESSURE	
			DEG. F	DEG. C		IN. OF HG	RATIO $P/P_o = \delta$
−2,000	1.0598	0.9714	66.132	18.962	1.0064	32.15	1.0744
−1,000	1.0296	0.9855	62.566	16.981	1.0030	31.02	1.0367
0	1.0000	1.0000	59.000	15.000	1.0000	29.92	1.0000
1,000	0.9711	1.0148	55.434	13.019	0.9966	28.86	0.9644
2,000	0.9428	1.0299	51.868	11.038	0.9931	27.82	0.9298
3,000	0.9151	1.0454	48.302	9.057	0.9896	26.82	0.8962
4,000	0.8881	1.0611	44.735	7.075	0.9862	25.84	0.8637
5,000	0.8617	1.0773	41.169	5.094	0.9827	24.90	0.8320
6,000	0.8359	1.0938	37.603	3.113	0.9792	23.98	0.8014
7,000	0.8106	1.1107	34.037	1.132	0.9756	23.09	0.7716
8,000	0.7860	1.1279	30.471	− 0.849	0.9721	22.22	0.7428
9,000	0.7620	1.1456	26.905	− 2.831	0.9686	21.39	0.7148
10,000	0.7385	1.1637	23.338	− 4.812	0.9650	20.58	0.6877
11,000	0.7156	1.1822	19.772	− 6.793	0.9614	19.79	0.6614
12,000	0.6932	1.2011	16.206	− 8.774	0.9579	19.03	0.6360
13,000	0.6713	1.2205	12.640	−10.756	0.9543	18.29	0.6113
14,000	0.6500	1.2403	9.074	−12.737	0.9507	17.58	0.5875
15,000	0.6292	1.2606	5.508	−14.718	0.9470	16.89	0.5643
16,000	0.6090	1.2815	1.941	−16.699	0.9434	16.22	0.5420
17,000	0.5892	1.3028	− 1.625	−18.681	0.9397	15.57	0.5203
18,000	0.5699	1.3246	− 5.191	−20.662	0.9361	14.94	0.4994
19,000	0.5511	1.3470	− 8.757	−22.643	0.9324	14.34	0.4791
20,000	0.5328	1.3700	−12.323	−24.624	0.9287	13.75	0.4595
21,000	0.5150	1.3935	−15.889	−26.605	0.9250	13.18	0.4406
22,000	0.4976	1.4176	−19.456	−28.587	0.9213	12.64	0.4223
23,000	0.4807	1.4424	−23.022	−30.568	0.9175	12.11	0.4046
24,000	0.4642	1.4678	−26.588	−32.549	0.9138	11.60	0.3876
25,000	0.4481	1.4938	−30.154	−34.530	0.9100	11.10	0.3711
26,000	0.4325	1.5206	−33.720	−36.511	0.9062	10.63	0.3552
27,000	0.4173	1.5480	−37.286	−38.492	0.9024	10.17	0.3398
28,000	0.4025	1.5762	−40.852	−40.473	0.8986	9.725	0.3250
29,000	0.3881	1.6052	−44.419	−42.455	0.8948	9.297	0.3107
30,000	0.3741	1.6349	−47.985	−44.436	0.8909	8.885	0.2970
31,000	0.3605	1.6654	−51.551	−46.417	0.8871	8.488	0.2837
32,000	0.3473	1.6968	−55.117	−48.398	0.8832	8.106	0.2709
33,000	0.3345	1.7291	−58.683	−50.379	0.8793	7.737	0.2586
34,000	0.3220	1.7623	−62.249	−52.361	0.8754	7.382	0.2467
35,000	0.3099	1.7964	−65.816	−54.342	0.8714	7.041	0.2353
36,000	0.2981	1.8315	−69.382	−56.323	0.8675	6.712	0.2243
37,000	0.2844	1.8753	−69.700	−56.500	0.8671	6.397	0.2138
38,000	0.2710	1.9209	−69.700	−56.500	0.8671	6.097	0.2038
39,000	0.2583	1.9677	−69.700	−56.500	0.8671	5.811	0.1942
40,000	0.2462	2.0155	−69.700	−56.500	0.8671	5.538	0.1851
41,000	0.2346	2.0645	−69.700	−56.500	0.8671	5.278	0.1764
42,000	0.2236	2.1148	−69.700	−56.500	0.8671	5.030	0.1681
43,000	0.2131	2.1662	−69.700	−56.500	0.8671	4.794	0.1602
44,000	0.2031	2.2189	−69.700	−56.500	0.8671	4.569	0.1527
45,000	0.1936	2.2728	−69.700	−56.500	0.8671	4.355	0.1455
46,000	0.1845	2.3281	−69.700	−56.500	0.8671	4.151	0.1387
47,000	0.1758	2.3848	−69.700	−56.500	0.8671	3.956	0.1322
48,000	0.1676	2.4428	−69.700	−56.500	0.8671	3.770	0.1260
49,000	0.1597	2.5022	−69.700	−56.500	0.8671	3.593	0.1201
50,000	0.1522	2.5630	−69.700	−56.500	0.8671	3.425	0.1145
51,000	0.1451	2.6254	−69.700	−56.500	0.8671	3.264	0.1091
52,000	0.1383	2.6892	−69.700	−56.500	0.8671	3.111	0.1040
53,000	0.1318	2.7546	−69.700	−56.500	0.8671	2.965	0.09909
54,000	0.1256	2.8216	−69.700	−56.500	0.8671	2.826	0.09444
55,000	0.1197	2.8903	−69.700	−56.500	0.8671	2.693	0.09001
56,000	0.1141	2.9606	−69.700	−56.500	0.8671	2.567	0.08578
57,000	0.1087	3.0326	−69.700	−56.500	0.8671	2.446	0.08176
58,000	0.1036	3.1063	−69.700	−56.500	0.8671	2.331	0.07792
59,000	0.09877	3.1819	−69.700	−56.500	0.8671	2.222	0.07426
60,000	0.09414	3.2593	−69.700	−56.500	0.8671	2.118	0.07078
61,000	0.08972	3.3386	−69.700	−56.500	0.8671	2.018	0.06746
62,000	0.08551	3.4198	−69.700	−56.500	0.8671	1.924	0.06429
63,000	0.08150	3.5029	−69.700	−56.500	0.8671	1.833	0.06127
64,000	0.07767	3.5881	−69.700	−56.500	0.8671	1.747	0.05840
65,000	0.07403	3.6754	−69.700	−56.500	0.8671	1.665	0.05566

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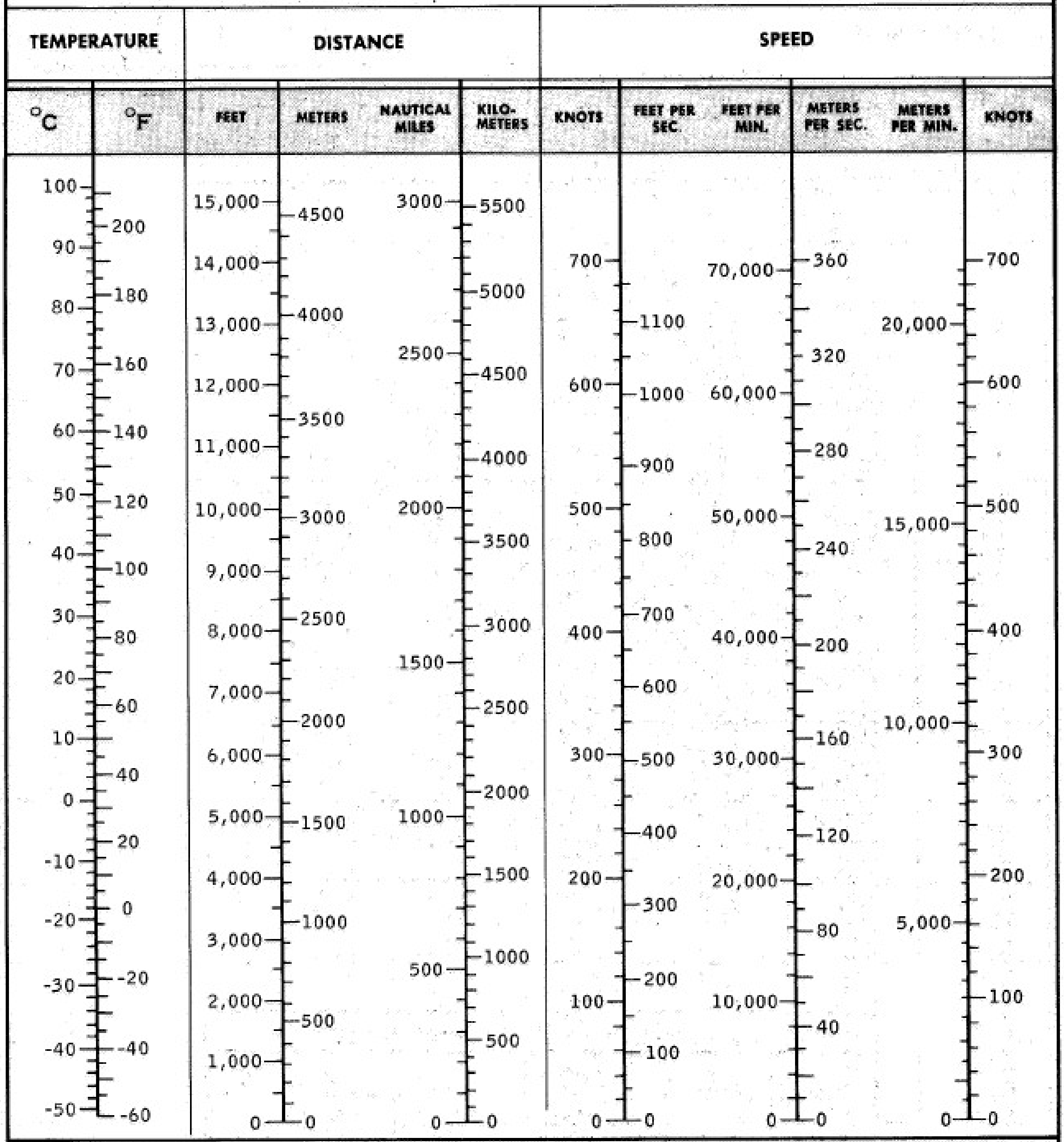
FA1-7.

STANDARD UNITS CONVERSION CHART



TEMPERATURE CONVERSION

$°F = \frac{9}{5}\ °C + 32°$

$°C = \frac{5}{9}\ (°F - 32°)$

US GALLONS = LITERS X 0.264

IMPERIAL GALLONS = LITERS X 0.220

INCHES OF MERCURY = MILLIBARS X 0.0295

POUNDS = KILOGRAMS X 2.20

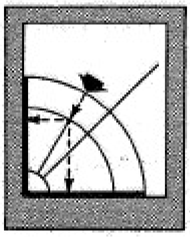
F-5 1-505(1)

FA1-8.

MODEL: F-5E/F
DATE: 1 MARCH 1978
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

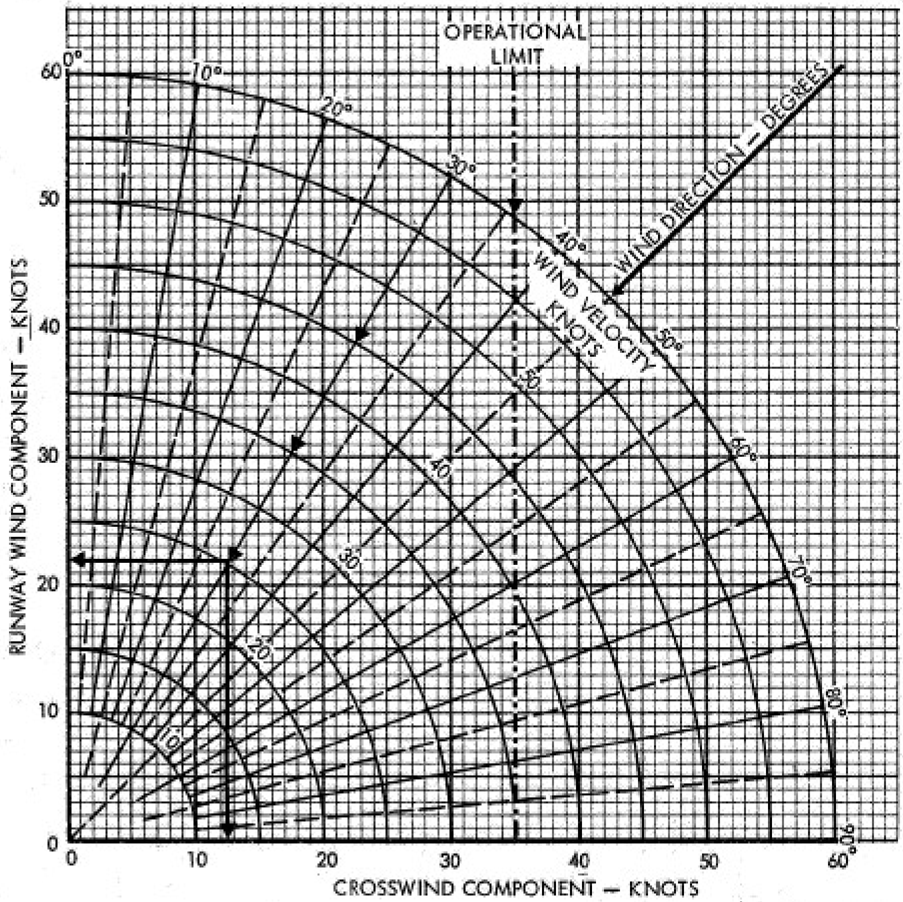
RUNWAY WIND COMPONENTS



Note

ENTER CHART WITH STEADY WIND TO DETERMINE HEADWIND OR TAILWIND COMPONENT AND WITH MAXIMUM GUST VELOCITY TO DETERMINE CROSS-WIND COMPONENT.

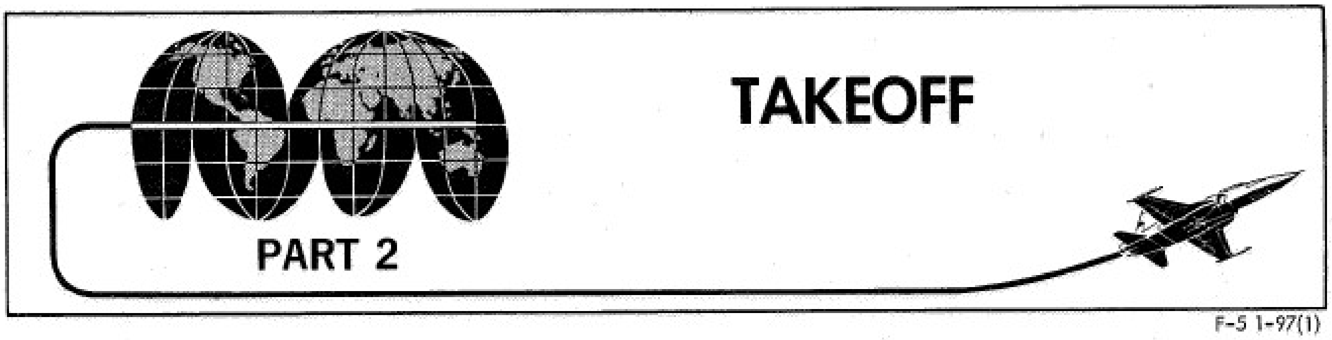
EXAMPLE:
RELATIVE WIND DIRECTION = 030°
RELATIVE WIND VELOCITY = 25 KT
RUNWAY WIND COMPONENT = 22 KT
CROSSWIND COMPONENT = 12.5 KT



90° — CROSSWIND LANDING LIMITATION			
GROSS WEIGHT (LB)	RUNWAY CONDITION	W/DRAG CHUTE	W/O DRAG CHUTE
		WIND VELOCITY (KT)	WIND VELOCITY (KT)
15,500 & BELOW	DRY WET ICY	20 10 5	35 20 10
ABOVE 15,500	DRY WET ICY	25 15 5	35 25 10

F-5 1-555(20)

FA1-9.



F-5 1-97(1)

TABLE OF CONTENTS **Page**

Page numbers underlined denote charts.

TAKEOFF PERFORMANCE CHARTS (GENERAL)

Takeoff charts are used to determine takeoff performance under normal or emergency operating conditions. The charts present takeoff speeds and distances based on two-engine operation for dry, hard-surfaced runways using takeoff procedures in section II. Data are based on full flaps, hiked position of the nosewheel, and auxiliary intake doors open. The charts apply to all loading configurations when the data is corrected for the effect of cg position. The effect of cg position is to increase baseline speed and distances for actual cg forward of 15% MAC and to decrease the speeds and distances for cg aft of 15% MAC.

AFT STICK, TAKEOFF, AND OBSTACLE CLEARANCE SPEED CHART

The Aft Stick, Takeoff, and Obstacle Clearance Speed chart is presented in FA2-2. The chart provides for various takeoff gross weight and cg positions and is intended for use with maximum thrust, minimum AB, or military thrust. Obstacle clearance speed is based on maximum thrust. Aft stick speed is 10 knots less than takeoff speed. Fuel flow values for ground taxi (57% rpm) and static military thrust runup are shown on the chart. The estimated fuel required for ground operation is subtracted from initial gross weight to obtain takeoff gross weight. Obstacle clearance speed is at least 20% higher than power-off stall speed, as compared to at least 10% higher at takeoff, and is obtained while maintaining an accelerating-climbing flight path at a constant angle of attack.

NOTE

Ⓕ If aircraft has a centerline store exceeding 1000 pounds (without wing stores), increase charted takeoff speed by 5 knots. Aft stick speed will be 10 knots less than this adjusted takeoff speed.

DEFINITIONS

AFT STICK SPEED: The speed during takeoff ground run at which the stick is moved aft for aircraft rotation to takeoff attitude.

TAKEOFF SPEED: Speed at which main gear lifts from runway.

OBSTACLE CLEARANCE SPEED: Speed necessary to obtain clearance distance.

USE

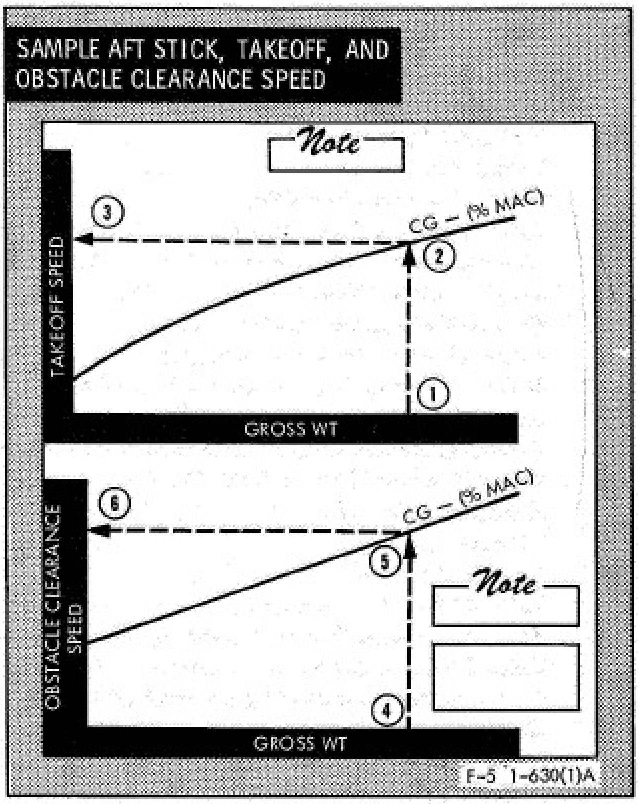
Enter the upper chart with takeoff gross weight and proceed up to the cg position, then left and read takeoff speed. To obtain aft stick speed, subtract 10 KIAS from the takeoff speed. To obtain obstacle clearance speed enter the lower chart with takeoff gross weight and cg and read the obstacle clearance speed.

SAMPLE PROBLEM

Given:

A. Takeoff gross weight: 18,000 lb.

B. CG position: 12% MAC.



Calculate:

A. Aft Stick, Takeoff, and Obstacle Clearance Speeds.

B. Use Aft Stick, Takeoff, and Obstacle Clearance Speed chart FA2-2. Enter upper chart.

① Gross Wt	18,000 lb.
② CG	12%MAC
③ Takeoff Speed	167 KIAS

C. Refer to note on chart for determining aft stick speed.

Thus: Takeoff Speed – 10 KIAS = Aft Stick Speed.
167 KIAS – 10 KIAS = 157 KIAS

D. Enter lower chart.

④ Gross Wt	18,000 lb.
⑤ CG	12%MAC
⑥ Obstacle Clearance Speed	183 KIAS

TIRE LIMIT SPEED CHART

The tire limit speed is 230 knots ground speed. The Tire Limit Speed chart (FA2-3) provides the tire limit speed in KIAS as a function of runway temperature and pressure altitude for zero wind. Wind velocity is added or subtracted to obtain corrected KIAS. Indicated takeoff (or landing) airspeed should never exceed the tire limit speed corrected for wind velocity.

DEFINITION

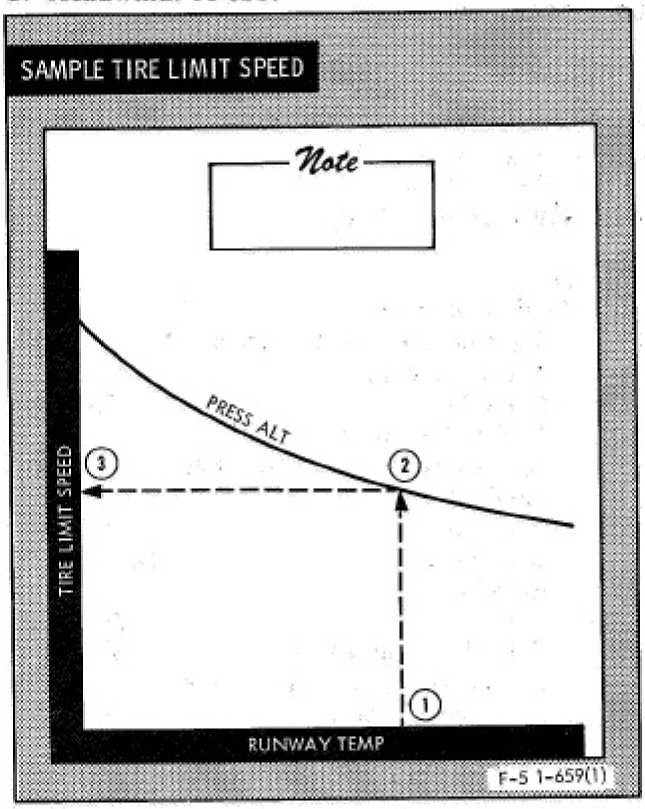
TIRE LIMIT SPEED: Maximum indicated airspeed allowable for safe operation of tires.

USE

Enter the chart with runway temperature, proceed up to the pressure altitude, then left to read zero wind tire limit speed. To correct for wind effect, add headwind or subtract tailwind velocity to obtain indicated airspeed.

SAMPLE PROBLEM

Given:
A. Runway temperature: +15°C.
B. Runway pressure altitude: Sea Level.
C. Headwind: 10 KT.



Calculate:
A. Tire limit speed.
B. Use Tire Limit Speed chart FA2-3.

①	Runway Temp	+15°C
②	Press Alt	Sea Level
③	Tire Limit Speed (zero wind)	230 KIAS

C. Refer to note on chart for wind effect.
Thus: Tire Limit Speed (zero wind) + Headwind = Tire Limit Speed (KIAS).
230 KT + 10KT = 240 KIAS

TAKEOFF FACTOR CHART

The Takeoff Factor chart for maximum, minimum afterburner, or military thrust (FA2-4) combines runway temperature, pressure altitude, and engine thrust into one quantity, called takeoff factor. The effect of engine anti-ice may also be included in the takeoff factor, if required. Takeoff factor used to define takeoff distance, critical field length, refusal speed and distance, critical engine failure speed, single-engine takeoff speed, 50-foot obstacle clearance distance, and a single-engine climb gradient.

USE

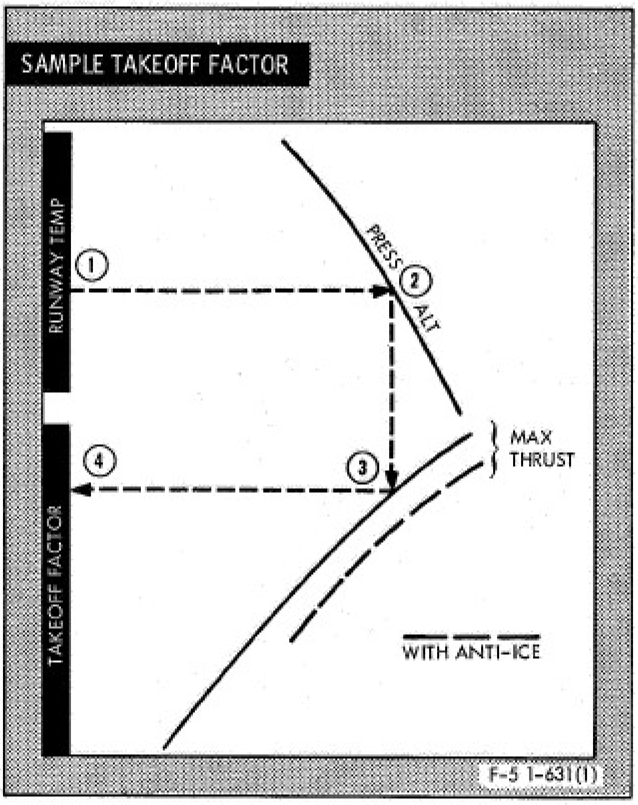
Enter the chart with the runway temperature and proceed right to the pressure altitude. At the intersection of temperature and altitude curves, proceed down to the desired thrust setting curve and then left to read the takeoff factor to the left. If anti-ice is required, the thrust setting line for anti-ice (indicated by dashed lines) is used in place of the corresponding solid thrust line.

SAMPLE PROBLEM

Given:
A. Runway temperature: +15°C.
B. Runway pressure altitude: Sea Level
C. Maximum thrust takeoff without anti-ice.

Calculate:
A. Takeoff factor.
B. Use Takeoff Factor chart FA2-4.

①	Runway Temp	+15° C
②	Press Alt	Sea Level
③	Max Thrust (w/o anti-ice)	
④	Takeoff Factor	12.0



TAKEOFF GROUND RUN CHART

Takeoff ground run is presented in FA2-5 as a function of takeoff factor. Corrections are provided in the chart for wind, cg position, and runway slope. If the chart is entered with a combination of a takeoff factor from 4 to 8 and an aircraft gross weight of 19,600 lb to 26,000 lb, the takeoff speed in figure FA2-2 must be corrected by the speed correction indicated in figure FA2-5. This additional speed is needed to overcome a thrust limited condition to attain a minimum of 300 fpm climb capability. If the aircraft cg is 20 % or more (aft), add the speed correction to the takeoff speed derived from figure FA2-2. If the aircraft cg is 20% or less (fwd), decrease the speed correction by 1 knot per 1% cg less than 20%, but never less than the correction speed. For example, if the speed correction is 8 knots and the cg is 15%, the correction should be reduced by 5 knots. Therefore, the adjusted speed correction is 3 knots. However, if the cg is 12% or less, the speed correction is 0 knots.

DEFINITIONS

TAKEOFF GROUND RUN: Ground run in feet from brake release to takeoff speed.

RUNWAY SLOPE: Expressed in percent (uphill or downhill), runway slope is the change in runway height divided by the runway length multiplied by 100.

USE

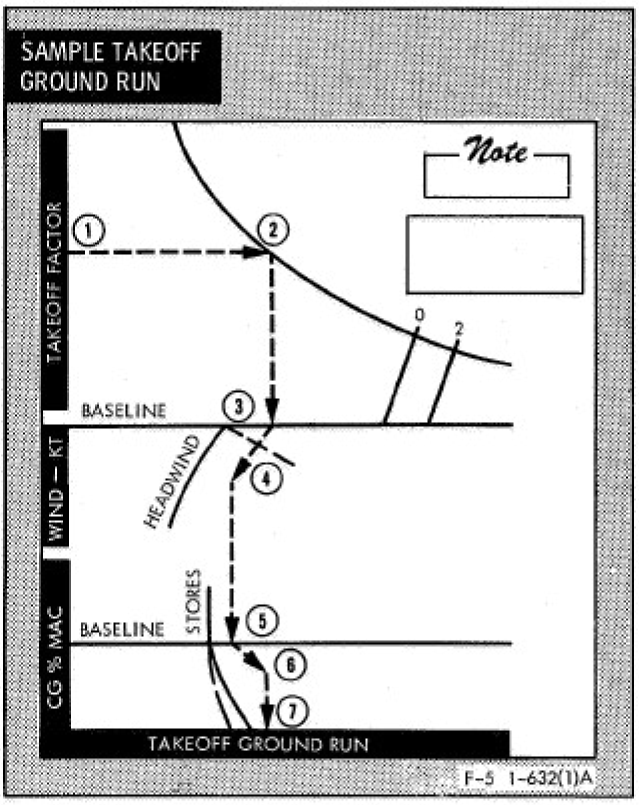
Enter the chart with takeoff factor and proceed right to takeoff gross weight. If the plot with the gross weight curve falls within the speed correction area, an increase in takeoff speed may be required. From this point, proceed down to the wind baseline. Contour the guidelines for headwind or tailwind to the wind velocity (if zero-wind conditions prevail, proceed directly thru) then continue down to the cg baseline. Contour the guidelines up or down for aft or forward cg, respectively, to the aircraft cg position. Dashed cg correction guidelines for no-stores configurations are provided for cg positions forward of 17% MAC. From this point, proceed down to read the required takeoff ground run. If the cg position is 15% MAC, proceed directly vertical thru the cg correction portion of the chart to obtain takeoff ground run. If an uphill runway slope correction is necessary, add the appropriate correction (see note on chart) to the ground run to obtain actual takeoff ground run.

SAMPLE PROBLEM

Given:
A. Takeoff factor: 12.0
B. Takeoff gross weight: 18,000 lb.
C. CG position: 12% MAC.
D. Headwind: 10 KT.
E. Runway slope: 1% uphill.

Calculate:
A. Takeoff ground run.
B. Use Takeoff Ground Run chart FA2-5.

①	Takeoff Factor	12.0
②	Gross Wt (Takeoff airspeed correction for cg position of 12% MAC not required)	18,000 lb
③	Baseline	———
④	Headwind	10 kt
⑤	Baseline	———
⑥	CG	12% MAC
⑦	Takeoff Ground Run	2600 ft
	Correction for 1% uphill slope (see note on chart)	+130 ft
	Corrected Takeoff Ground Run	2730 ft



TOTAL OBSTACLE CLEARANCE DISTANCE CHART

The total 50-foot Obstacle Clearance Distance chart is presented in FA2-6 as a function of takeoff ground run corrected for headwind or tailwind, as appropriate, and cg position. Total obstacle clearance distance data is based on the use of maximum thrust only.

DEFINITION

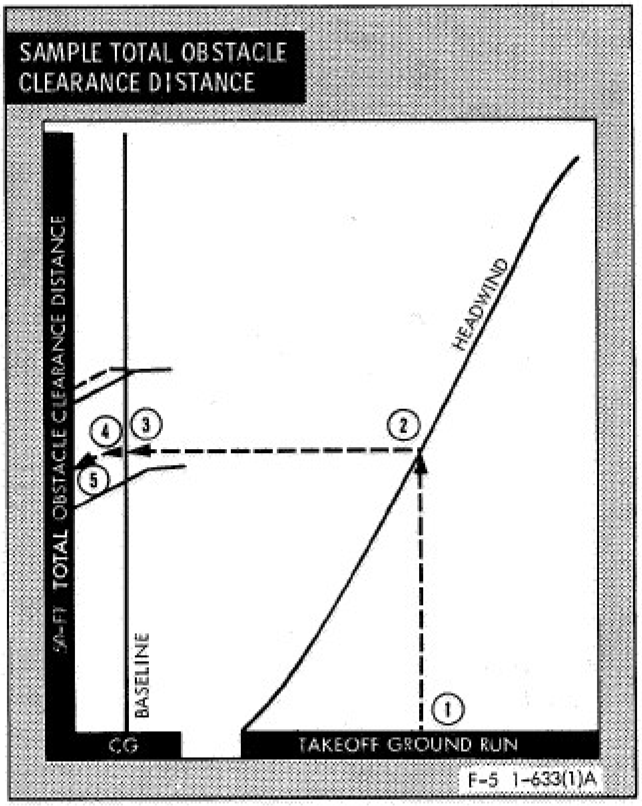
TOTAL OBSTACLE CLEARANCE DISTANCE: Horizontal distance from brake release to 50-foot height when accelerating between takeoff and obstacle clearance speeds.

USE

Enter with takeoff ground run corrected for wind, cg position, and runway slope and proceed up to the wind curve, then left to the baseline. Contour the nearest guideline to the cg position and at this point project left and read 50-foot obstacle clearance distance. The dashed guidelines within the cg plotting grid are to be used for no-stores configurations which enter this area of the chart, instead of the solid guidelines which represent store configurations. If the cg position is 15%, proceed directly from the baseline to read total obstacle clearance distance.

SAMPLE PROBLEM

Given:
A. Corrected takeoff ground run: 2730 ft.
B. Headwind: 10 kt.
C. CG position (with stores): 12% MAC



Calculate:
A. 50-Foot total obstacle clearance distance.
B. Use Total Obstacle Clearance Distance chart FA2-6.

①	Takeoff Ground Run	2730 ft.
②	Headwind	10 kt
③	Baseline	———
④	CG	12%MAC
⑤	50-Foot Total Obstacle Clearance Distance	3950 ft

MINIMUM SAFE SINGLE-ENGINE TAKEOFF SPEED CHARTS

The Minimum Safe Single-Engine Takeoff Speed chart for maximum thrust is presented in FA2-7. The chart provides minimum safe single-engine takeoff speed as a function of maximum thrust takeoff factor, pressure altitude, gross weight, and cg position. The single-engine takeoff speed should be compared with tire limit speed to assure safe operation of the aircraft.

Maximum gross weight takeoff capability can be obtained by reading up from "Maximum Gross Weight Capability" dashed curves into the gross weight lines, starting with applicable cg. The intersection of this line with one coming from the takeoff thrust factor pressure altitude grid will determine the desired maximum gross weight capability for 300 fpm rate of climb. The required speeds for this performance provide minimum drag.

DEFINITION

MINIMUM SAFE SINGLE-ENGINE TAKEOFF SPEED: Minimum speed out of ground effect, at which the aircraft can maintain a 300 fpm rate of climb with one engine inoperative while in the takeoff configuration.

USE

Enter the chart with maximum thrust takeoff factor and proceed up to the pressure altitude, then right to the gross weight. From this point, move down to the cg position and then proceed left to the second set of gross weight curves. At this intersection, move down and read the single-engine takeoff speed.

WARNING

If gross weight or cg curves cannot be intersected, safe single-engine takeoff cannot be made.

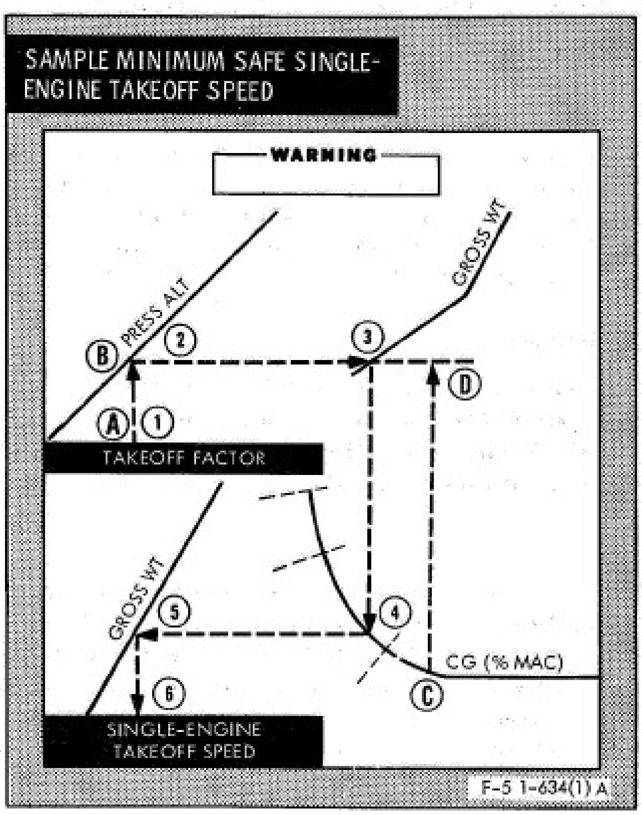
NOTE

Obtain at least the higher of either the minimum safe single-engine speed or the obstacle clearance speed (for two-engine operation) as soon as possible after a takeoff with both engines operating.

To obtain maximum gross weight takeoff capability, determine the desired maximum takeoff thrust factor, pressure altitude, and aircraft cg and gross weight. Enter the Minimum Safe Single-Engine Takeoff Speed chart with the maximum thrust takeoff factor and pressure altitude, then construct a line thru the gross weight curves. Reenter the chart at the Maximum Gross Weight Capability (dashed lines) within the cg position curves with the estimated gross weight and cg. Proceed upward to intersect the constructed horizontal line. If the gross weight at this point and the estimated gross weight are the same: this is the maximum gross weight for takeoff. If the gross weight of the estimated configuration exceeds the gross weight plotted at the intersection point, a single engine takeoff at that gross weight cannot be accomplished. The chart must be reentered with a different authorized configuration gross weight/cg until a coincidental or slightly lower maximum gross weight is determined.

SAMPLE PROBLEM

Given:
A. Takeoff factor (maximum thrust):12.
B. Runway pressure altitude: Sea Level.
C. Takeoff gross weight (with stores): 18,000 lb.
D. CG position: 12% MAC.



Calculate:

A. Minimum safe single-engine takeoff speed.

B. Use Minimum Safe Single-Engine Takeoff Speed chart, FA2-7.

①	Takeoff Factor (max thrust)	12.0
②	Press Alt	Sea Level.
③	Gross Wt	18,000 lb
④	CG	12%MAC
⑤	Gross Wt	18,000 lb
⑥	Single-Engine Takeoff Speed	171 KIAS

C. Maximum gross weight capability. Use FA2-7.

Ⓐ	Takeoff Factor (max thrust)	12.0
Ⓑ	Press Alt	Sea Level
Ⓒ	Gross Wt and CG (Estimated)	21,000 lb/ 10% MAC
Ⓓ	Gross Wt (Calculated)	19,600 lb

The estimated gross weight and the calculated gross weight are not equal: therefore, chart must be reentered with different weight/cg configuration until this requirement is satisified.

Ⓒ	Gross Wt and CG (Estimated)	20,000 lb/ 10% MAC
Ⓓ	Gross Wt (Calculated)	20,000 lb

SINGLE ENGINE CLIMB GRADIENT CHARTS

The Single-Engine Climb Gradient at Obstacle Clearance Speed charts for landing gear down and up with full flaps at maximum thrust are presented in FA2-8 and FA2-9, respectively. The charts provide single-engine rate of climb and the climb gradient in feet-per-nautical mile, or percent, as a function of maximum thrust takeoff factor, pressure altitude, and gross weight. Gross weight is limited to conditions under which the aircraft can maintain a 300 feet-per-minute rate of climb at 50-foot obstacle clearance speed. It is possible to improve aircraft performance by flying slightly faster than obstacle speed to reduce drag. For example, maximum gross weight capability for 300 fpm climb rate with single engine will be improved significantly by doing so, as indicated on the Minimum Safe Single-Engine Takeoff Speed Charts.

DEFINITIONS

CLIMB GRADIENT: The slope of the flight path as it increases in altitude from the point of liftoff from the runway in relationship to the horizontal distance flown over the ground. For example, a 10% climb gradient represents 100 feet increase in altitude for each 1000 feet of horizontal distance flown along the flight path or 608 feet increase for every nautical mile (6076 ft X 10% = 608 ft).

SINGLE-ENGINE CLIMB GRADIENT: The climb gradient, out of ground effect, in feet-per-nautical mile or percent that the aircraft can climb with one engine at maximum thrust and the other engine windmilling.

USE

Enter the appropriate chart with maximum thrust takeoff factor and proceed up to the pressure altitude, then right to the gross weight. From this point move down to the cg correction baseline for the rate of climb. For cg position more than 15% MAC, contour the upper guidelines of the grid; for cg position less than 15% MAC, contour the lower guidelines of the grid. If cg position is 15% MAC, proceed appropriately directly thru the baseline and move down to the reflector line and then left to the baseline. For tailwind conditions, contour the nearest guideline to the tailwind velocity. At this point of intersection, proceed left and read the climb gradient in percent and/or feet-per-nautical mile. For zero and headwind conditions, proceed left directly from the baseline to obtain climb gradient. To obtain climb gradient in the event of single-engine go-around during a landing approach, enter the appropriate chart with the maximum thrust takeoff factor, pressure altitude, and landing gross weight.

WARNING

If gross weight curve cannot be intersected, single engine climb cannot be made at obstacle clearance speed. Reenter Minimum Single-Engine Takeoff Speed chart. If gross weight and cg curve can be intersected, a 300 fpm rate of climb can be made and the resulting minimum safe single-engine takeoff speed would be higher than the obstacle clearance speed and should be used as the minimum airspeed.

SAMPLE PROBLEM

Given:

A. Single-engine climb, maximum thrust, full flaps, and gear down.

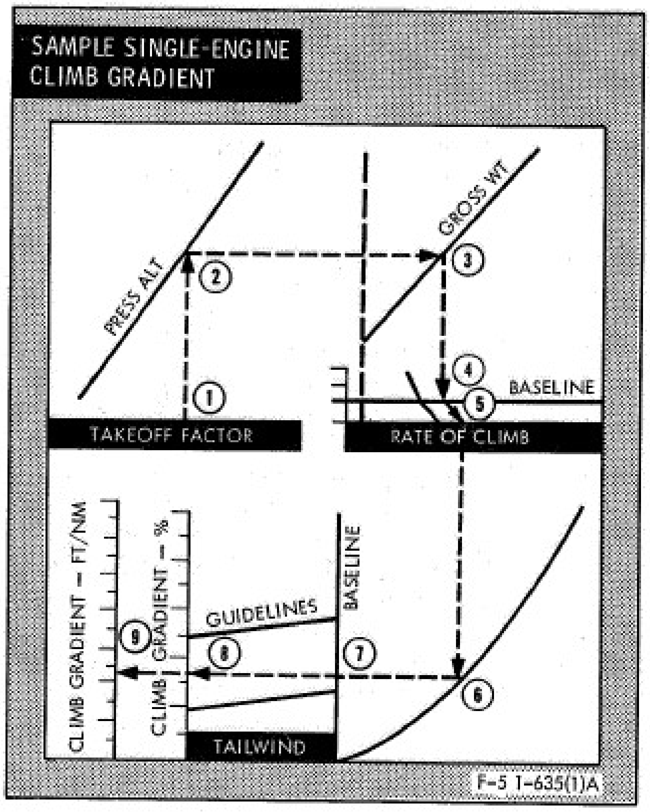
B. Takeoff factor: 12.0

C. Runway pressure altitude: Sea Level.

D. Takeoff gross weight (with stores): 18,000 lb.

Calculate:

A. Single-engine rate of climb and climb gradient at 50-foot obstacle clearance speed.



B. Use Single-Engine Climb Gradient at Obstacle Clearance Speed chart, Gear Down, FA2-8.

①	Takeoff Factor (max thrust)	12.0
②	Press Alt	Sea Level
③	Gross Wt	18,000 lb
④	Base Line	12% MAC
⑤	Rate of Climb	450 fpm
⑥	Reflector	———
⑦	Baseline	———
⑧	Climb Gradient	2.5%
⑨	Climb Gradient	150 ft/nm

CRITICAL FIELD LENGTH CHARTS

The Critical Field Length charts for no drag chute and with drag chute are contained in FA2-10 and FA2-11, respectively. Distances shown in the charts are based on maximum thrust acceleration to engine failure and continuous brake application during stopping phase. The aft stick speed line in both charts represents the condition at which critical engine failure speed is the same as maximum thrust two-engine aft stick speed. A calculated takeoff factor that intersects a given takeoff gross weight in the No Drag Chute chart and fails to intersect the same takeoff gross weight curve in the With Drag Chute chart, indicates that with drag chute the aft stick speed is the limiting factor for critical engine failure speed. The braking friction required to provide consistent minimum stopping distances on a dry, hard-surfaced runway is designated as heavy braking and corresponds to a runway condition reading (RCR) of 23. This is the baseline condition used in the charts. The charts apply takeoff factor, gross weight, wind, cg position, and RCR correction curves to obtain critical field length. In addition, a correction for runway slope (see note on chart) is provided. In the With Drag Chute chart, the chute is assumed deployed at any speed for abort.

DEFINITION

CRITICAL FIELD LENGTH: Total distance required for the aircraft to accelerate on both engines to the critical engine failure speed, experience an engine failure, and then either continue the takeoff or stop.

RUNWAY CONDITION READING (RCR): A number that indicates the degree of braking friction available on the runway surface (obtainable from base operations).

NOTE

Approximate RCR value for a wet, hard-surfaced runway could vary anywhere from 12 without standing water to 7 with standing water.

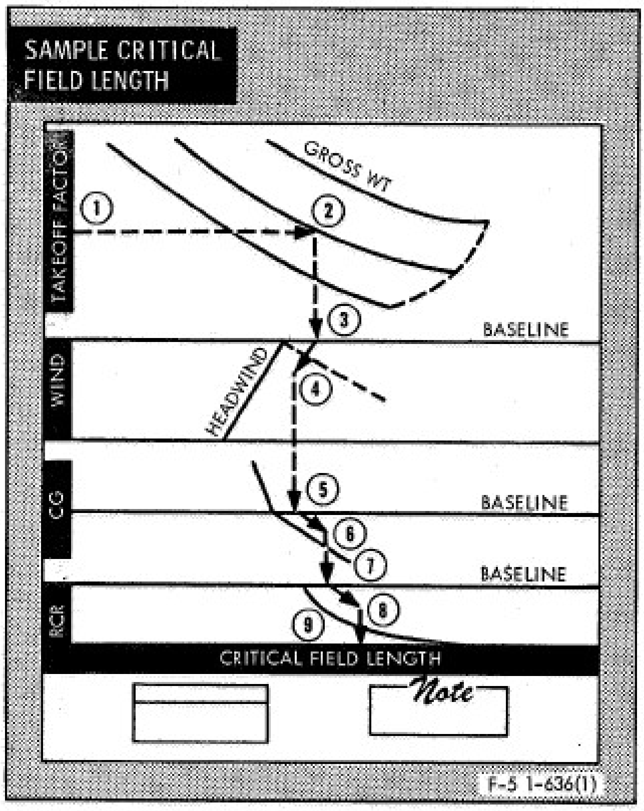
USE

Enter appropriate chart with takeoff factor, proceed right to gross weight and then down to the wind baseline. Contour the guidelines for headwind or tailwind to the wind velocity (if no wind, proceed down from baseline) and then down to the cg correction baseline. For cg positions more than 15% MAC, it is necessary to contour the upper guidelines of the grid; for cg positions less than 15% MAC, contour the lower guidelines of the grid prior to proceeding down to the RCR baseline. If the cg position is 15% MAC, proceed directly thru the cg correction portion of the chart to the RCR baseline. Contour the guidelines to the RCR and then continue down to read critical field length. If operating from a dry, hard-surfaced runway, proceed directly thru the RCR correction portion of the chart. If a runway slope correction is necessary, add or subtract the appropriate distance (see note on chart) to or from the previously read critical field length to obtain critical field length corrected for runway slope.

SAMPLE PROBLEM

Given:

A. Maximum thrust takeoff and no drag chute condition for abort.
B. Takeoff factor: 12.0
C. Takeoff gross weight (with stores): 18,000 lb.
D. Runway headwind: 10 kt.
E. CG position: 12% MAC.
F. Runway surface: Wet, hard-surfaced (RCR 12).
G. Runway slope: 1% uphill.



Calculate:

A. Critical field length.
B. Use Critical Field Length chart, No Drag Chute, FA2-10.

①	Takeoff Factor	12.0
②	Gross Wt	18,000 lb
③	Baseline	———
④	Headwind	10 kt
⑤	Baseline	———
⑥	CG	12%
⑦	Baseline (RCR 23; Dry, Hard-Surfaced Runway)	4950 ft
⑧	RCR for Wet, Hard-Surfaced Runway (see reference on chart)	12
⑨	Critical Field Length	5450 ft
	Correction for 1% uphill slope (see note on chart)	+273 ft
	Corrected Critical Field Length	5723 ft

CRITICAL ENGINE FAILURE OR REFUSAL SPEED CHARTS

Critical Engine Failure or Refusal Speed charts are presented in FA2-12 thru and FA2-14. FA2-12 is based on maximum or military thrust without drag chute and is used to determine critical engine failure and refusal speeds. FA2-13 is based on maximum thrust with drag chute and is used to determine critical engine failure and refusal speeds. FA2-14 is based on military thrust with drag chute and is used to determine refusal speed. Takeoff factor, gross weight, and runway length is used to determine refusal speed. Takeoff factor, gross weight, and critical field length obtained from FA2-10 or FA2-11 is used to determine critical engine failure speed. The computed critical engine failure speed is always higher with the use of drag chute than without the use of drag chute because of shorter stopping distance resulting from additional deceleration with deployment of drag chute. Initial entry into the charts is made with a critical field length for dry, hard-surfaced runway conditions; as the corrections provided for RCR change the speed from that for a dry, hard-surfaced runway to that for the surface condition corresponding to the RCR of interest. An RCR of 23 is used as the baseline condition as this corresponds to the braking friction required to provide consistent minimum stopping distances on a dry, hard-surfaced runway. In the use of drag chute chart, the chute is assumed deployed at any speed for abort.

NOTE

The RCR Correction curves for Refusal Speed and Critical Engine Failure Speed are to be used only to correct for surface conditions not applicable to a dry, hard-surfaced runway; for example, wet or icy surface.

DEFINITION

CRITICAL ENGINE FAILURE SPEED: Speed at which an engine failure permits acceleration to takeoff in the same distance required to decelerate the aircraft to a stop.

REFUSAL SPEED: Maximum speed to which the aircraft can accelerate with two-engine thrust and then stop in the remaining runway length.

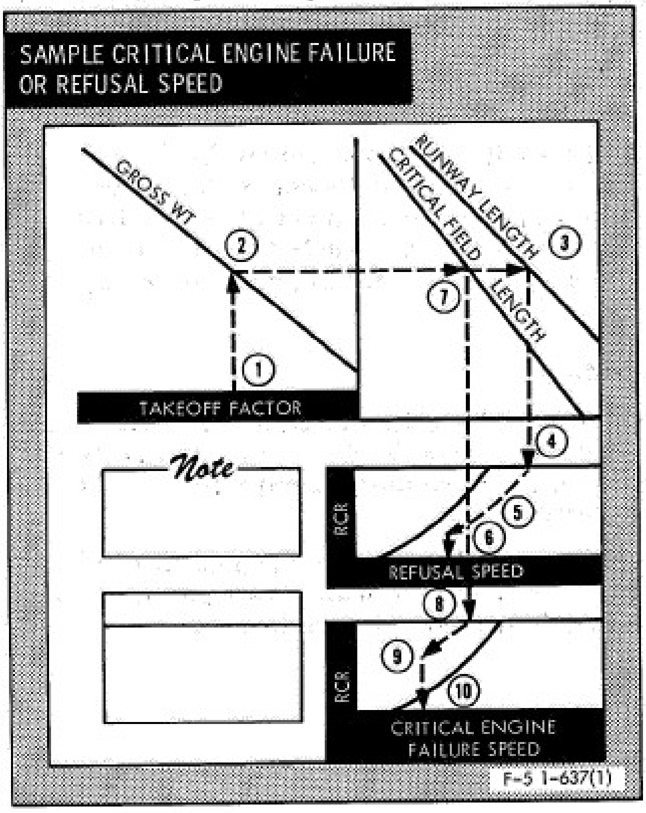
USE

Enter appropriate chart with takeoff factor and move up to gross weight. Proceed right to the known value of actual runway length, and then down to the RCR baseline for refusal speed. Contour the guidelines to the RCR value, and then proceed down to the refusal speed. Critical engine failure speed is determined by using FA2-12 or FA2-13 and is read in the same manner as refusal speed except that the critical field length (obtained from FA2-10 or FA2-11) is used in place of the actual field length and the RCR correction for critical engine failure speed is used in place of the RCR correction for refusal speed. The value of critical field length used in the chart is always for dry, hard-surfaced runway conditions. Wind correction is obtained from note on chart.

SAMPLE PROBLEM

Given:

A. Maximum thrust takeoff and no drag chute condition for abort.
B. Takeoff factor: 12.0
C. Takeoff gross weight (with stores): 18,000 lb.
D. Runway length: 10,000 ft.
E. Runway surface: Wet, Hard-Surfaced (RCR 12).
F. Critical field length for dry, hard-surfaced runway (RCR 23) (from FA2-10): 4950 ft.
G. Runway headwind: 10 kt.
H. Runway slope: 1% uphill.



Calculate:

A. Critical engine failure speed and refusal speed.
B. Use Critical Engine Failure or Refusal Speed chart, No Drag Chute, FA2-12.

① Takeoff Factor	12.0
② Gross Wt	18,000 lb
③ Runway Length	10,000 ft
④ Baseline (RCR 23)	———
⑤ RCR for Wet, Hard-Surfaced Runway (see reference on chart)	12
⑥ Refusal Speed	155 KIAS
Correction for Headwind (See note on chart)	+ 10 KT
Corrected Refusal Speed (for wet, hard-surfaced runway and headwind)	165 KI.

C. Reenter chart at step ② and plot for critical engine failure speed.

⑦ Critical Field Length (from FA2-10, for dry, hard-surfaced runway)	4950 ft
Correction for 1% uphill slope (from FA2-10)	+ 248 ft
Corrected Critical Field Length	5198 ft
⑧ Baseline (RCR 23)	———
⑨ RCR for Wet, Hard-Surfaced Runway (see reference on chart)	12
⑩ Critical Engine Failure Speed	107 KIAS
Correction for Headwind (see note on chart)	+ 10 KT
Corrected Critical Engine Failure Speed (for wet, hard-surfaced runway and headwind)	117 KIAS

VELOCITY DURING TAKEOFF GROUND RUN CHART

The Velocity During Takeoff Ground Run chart (FA2-15) is used to determine speed/distance traveled during takeoff ground run. In particular, it is used to determine the acceleration check speed.

DEFINITIONS

GO/NO-GO SPEED: Same as Critical Engine Failure Speed (if this speed exceeds refusal speed, there is no GO/NO-GO speed).

REFUSAL DISTANCE: Distance required to accelerate from brake release to refusal speed.

USE

Establish a point on the chart at takeoff speed and takeoff ground run read from FA2-2 and FA2-5, respectively. The ground run is corrected for wind, cg, and runway slope. Construct a line thru the point contouring the nearest guideline. This line represents the normal speed-distance relationship during takeoff. If the takeoff distance is 3000 feet or greater, enter the chart at the 2000-foot distance and read the speed at that point on the normal acceleration line. If takeoff distance is less than 3000 feet, check the speed at the 1000-foot distance. This is the normal acceleration speed at that distance. To determine acceleration tolerance, subtract 3 knots for each 1000 feet of runway in excess of normal critical field length or 10 knots, whichever is less, for normal acceleration speed. This corrected speed is the acceleration check speed at the 2000-foot (or 1000-foot) marker. The critical engine failure speed is used as GO/NO-GO for category 1 and 2 abort situations. There is no GO/NO-GO speed for category 3. (Abort categories are discussed in detail following the sample problem.)

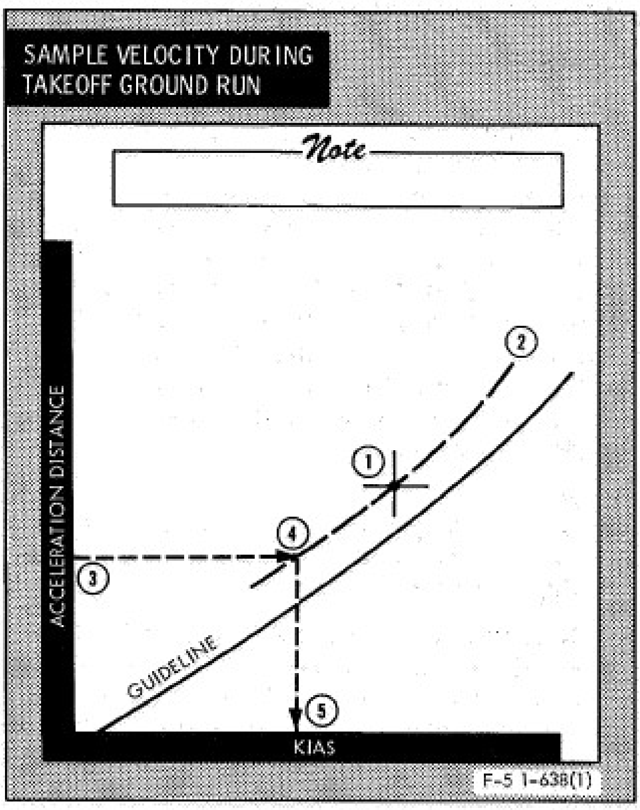
SAMPLE PROBLEM

Given:

A. Maximum thrust takeoff and no drag chute.
B. Takeoff gross weight (with stores): 18,000 lb.
C. CG: 12% MAC.
D. Runway pressure altitude: Sea Level.
E. Runway surface. Wet, hard-surfaced (RCR 12).
F. Runway length: 10,000 ft.
G. Runway slope: 1% uphill.
H. Runway headwind: 10 kt.
I. Takeoff factor: 12
J. Takeoff speed: 167 KIAS.
K. Takeoff ground run (corrected for headwind, cg, and uphill runway): 2730 ft.
L. Critical field length: 5723 ft.
M. Critical engine failure speed: 117 KIAS.

Calculate:

A. Acceleration check speed at the 2000-foot marker.
B. Use Velocity During Takeoff Ground Run chart FA2-15.
   ① Establish Point on Chart (defined by takeoff speed of 167 KIAS and takeoff ground run of 2730 ft.) —— +
   ② Construct Contour Line thru Point. — — — —
C. Determine normal acceleration speed:
   ③ Acceleration Distance: 2000 ft



   ④ Intersect Constructed Contour Line ——
   ⑤ Normal Acceleration Speed 145 KIAS

D. To determine acceleration tolerance, subtract 3 knots for each 1000 feet of runway in excess of critical field length of 10 knots, whichever is less, from normal acceleration speed:

Thus:

$$\frac{\text{Runway Length} - \text{Critical Field Length}}{1000} \times 3$$

$= $ Acceleration Tolerance

$$\frac{10{,}000 - 5723}{1000} \times 3 = 12.83$$

therefore, use 10 KIAS

E. Acceleration check speed at 2000-foot marker: Thus:

145 KIAS (normal acceleration speed)
−10 KIAS (acceleration tolerance)
135 KIAS

F. If acceleration is acceptable at 2000 feet, continue takeoff, using the critical engine failure speed as GO/NO-GO speed. This is a category 1 abort condition.

ABORT TAKEOFF CHARTS (GENERAL)

The abort takeoff charts contained in FA2-7 thru FA2-15 provide the means of planning for a GO/NO-GO decision if an engine fails during takeoff. This discussion of the GO/NO-GO concept illustrates the factors which influence the decision to stop or go if an engine fails. The principal factor affecting an aborted takeoff is the relationship of actual runway length to critical field length, which falls into three categories; within each category, the speed at which engine fails further affects the stop or go decision as follows:

Category 1.

Runway length Greater Than Critical Field Length. (Refusal Speed Exceeds Critical Engine Failure Speed.)

a. If engine failure occurs before GO/NO-GO speed, aircraft should be stopped; runway length will always be sufficient for stopping.
b. If engine failure occurs between GO/NO-GO and Refusal Speeds, takeoff can be continued or aborted in the remaining distance. The decision to take off or abort depends on operational factors such as aircraft loading, length and condition of overruns, traffic pattern obstructions, and terrain clearance.
c. If an engine fails after Refusal Speed, continue takeoff. Sufficient runway for takeoff will always be available.

Category 2.

Runway Length Same as Critical Field Length. (Refusal Speed Equals Critical Engine Failure Speed.)

Refusal speed and critical engine failure speed are the same; therefore aircraft must be stopped if engine failure occurs before the speed and should continue takeoff if engine failure occurs after the speed. Runway will be adequate for either condition.

Category 3.

Runway Length Less Than Critical Field Length. (Refusal Speed Less Than Critical Engine Failure Speed.)

This category is the most critical because GO/NO-GO speed is nonexistent and should be carefully evaluated as follows:

a. If engine failure occurs before refusal speed, aircraft must be stopped. Runway will always be sufficient for stopping.
b. If engine failure occurs after refusal speed, aircraft cannot stop within the remaining runway; however, takeoff may be possible if gross weight is reduced by jettisoning external stores.

When the drag chute is used, distances plotted in the abort charts for stopping on the runway are based on deployment at any speed.

WARNING

Military thrust takeoff is not recommended unless takeoff speed is less than military thrust refusal speed.

CRITICAL OBSTACLE CLEARANCE DISTANCE WITH ENGINE FAILURE DURING TAKEOFF

When carrying external stores, the following procedures may be used to evaluate critical obstacle clearance capability in the event of engine failure during takeoff in which the failure occurs at the critical engine failure speed (most critical speed). Pylons stores are jettisoned and single-engine takeoff is accomplished when obstacle clearance speed is obtained.

USE

After using Velocity During Takeoff Ground Run chart (FA2-15) to determine normal acceleration check speed, reenter chart to obtain critical obstacle clearance distance with engine failure on takeoff. Use the following procedures:

a. Reenter FA2-15 at the constructed point (Point A) representing two-engine takeoff speed and distance (with stores) and the constructed contour line Ⓑ thru this point. Plot the critical engine failure speed (with stores) Ⓒ on the constructed contour line (Point Ⓓ). This point is the acceleration distance to engine failure.
b. Plot critical field length and safe single-engine takeoff speed (with stores) (Point Ⓕ). This would be the point for single-engine takeoff with stores.
c. Construct a straight line Ⓖ between points Ⓓ and Ⓕ. On this line plot obstacle clearance speed (determined for aircraft weight with stores jettisoned) (Point Ⓘ). This is the distance from brake release to the point where stores are jettisoned and liftoff is accomplished, as read from the acceleration distance scale, Ⓙ.

d. Enter the Single-Engine Climb Gradient charts (FA2-8 and FA2-9) to determine the horizontal distance required from single-engine takeoff to clear a given obstacle.

SAMPLE PROBLEM

Determine the horizontal distance from brake release to clear a 250-foot obstacle with engine failure occurring at critical engine failure speed.

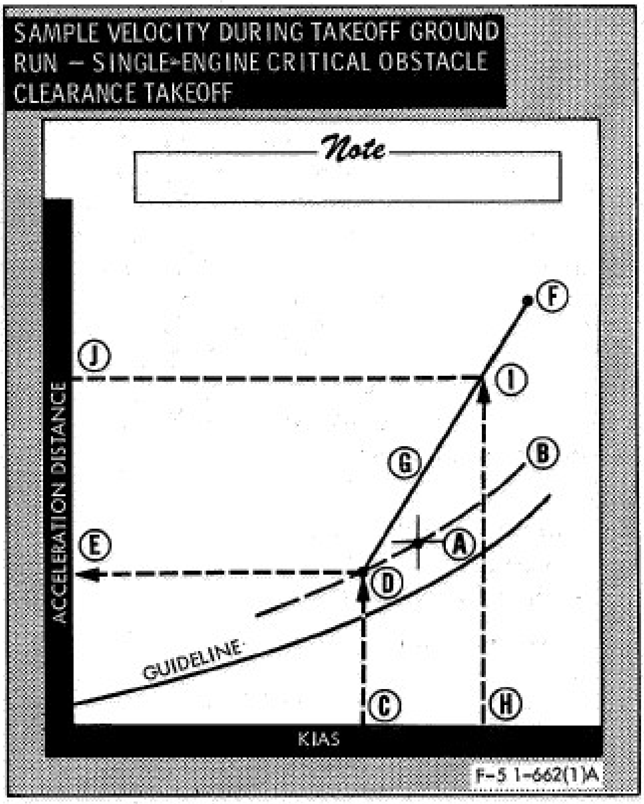
Given:

A. Takeoff gross weight (with stores): 18,000 lb.
B. CG: 12% MAC.
C. Runway pressure altitude: Sea Level.
D. Takeoff factor: 12.0
E. Runway surface: wet, hard-surfaced (RCR 12).
F. Runway length: 10,000 ft.
G. Runway temperature: + 15°C.
H. Runway slope: 1% uphill.
I. Runway headwind: 10 KIAS.
J. Takeoff speed (two-engine): 167 KIAS.
K. Takeoff distance (two engine): 2730 ft.
L. Critical field length (no drag chute): 5723 ft.
M. Critical engine failure speed (no drag chute): 117 KIAS.
N. Safe single-engine takeoff speed (FA2-7): 171 KIAS.
O. Takeoff gross weight (stores jettisoned): 16,500 lb.
P. CG (stores jettisoned): 12% MAC.
Q. Obstacle clearance speed (stores jettisoned) (FA2-2): 176 KIAS.
R. Single-engine climb gradient, gear down (FA2-8): 5.5%.
S. Horizontal distance to 50 ft obstacle, gear down (50 ÷ 0.055)= 909 ft.
T. Horizontal distance to 200 ft obstacle, gear up (200 ÷ 0.055)= 3636 ft.
U. Single-engine climb gradient, gear up (FA2-9): 9.6%.
V. Horizontal distance to climb 200 ft, gear up (200 ÷ 0.096)= 2083 ft.

Calculate:

A. Total distance from brake release to clear 250 ft obstacle (gear up or down) = Ground Run Distance from Brake Release to Stores Jettison and Liftoff + Horizontal Distances to 50 Ft Altitude (gear down) + Horizontal Distance to Climb 200 Ft (gear up or down).
B. Use Velocity During Takeoff Ground Run chart, FA2-15.

Ⓐ	Point Previously Established by Takeoff Speed (167 KIAS) and Takeoff Ground Run (2730 ft) (two engines, with stores)	+
Ⓑ	Contour Line Constructed Thru Point	— — —
Ⓒ	Critical Engine Failure Speed	117 KIAS
Ⓓ	Intersect Constructed Contour Line	— — —
Ⓔ	Acceleration Distance to Engine Failure (with stores)	1300 ft
Ⓕ	Establish Point Defined by Critical Field Length (with stores) and Safe Single-Engine Takeoff Speed (with stores)	5723 ft and 171 KIAS
Ⓖ	Construct Line Between Ⓓ and Ⓕ	———
Ⓗ	Obstacle Clearance Speed (stores jettisoned)	176 KIAS
Ⓘ	Intersect Line Ⓓ Ⓕ	
Ⓙ	Ground Distance From Brake Release to Stores Jettison and Liftoff	6150 ft



C. Use Single-Engine Climb Gradient chart data (FA2-8 and FA2-9) and calculations in given data, above:

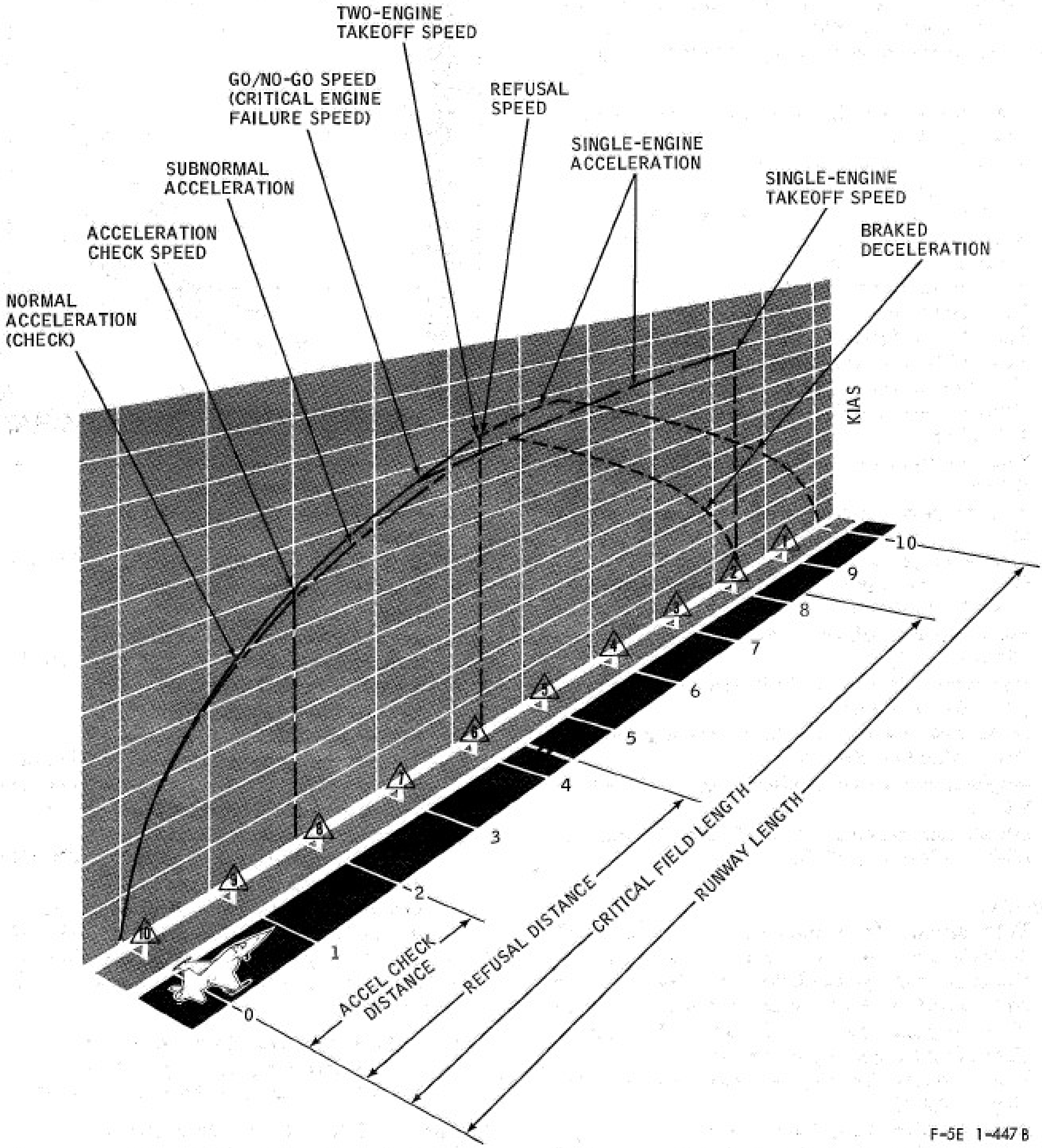
Thus: Total Distance from Brake Release to Clear 250 Ft Obstacle (gear down):
6150 ft + 909 ft + 3636 ft = 10,695 ft

If climb to 250 ft altitude is with gear up:

Thus: Total Distance from Brake Release to Clear 250 Ft Obstacle (gear up):
6150 ft + 909 ft + 2083 ft = 9142 ft

TAKEOFF/ABORT CRITERIA

(GO/NO-GO CONCEPT)



F-5E 1-447 B

FA2-1.

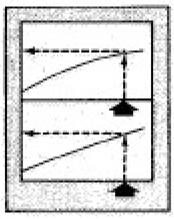
MODEL: F-5E/F
DATE: 1 AUGUST 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

AFT STICK, TAKEOFF, AND OBSTACLE CLEARANCE SPEED

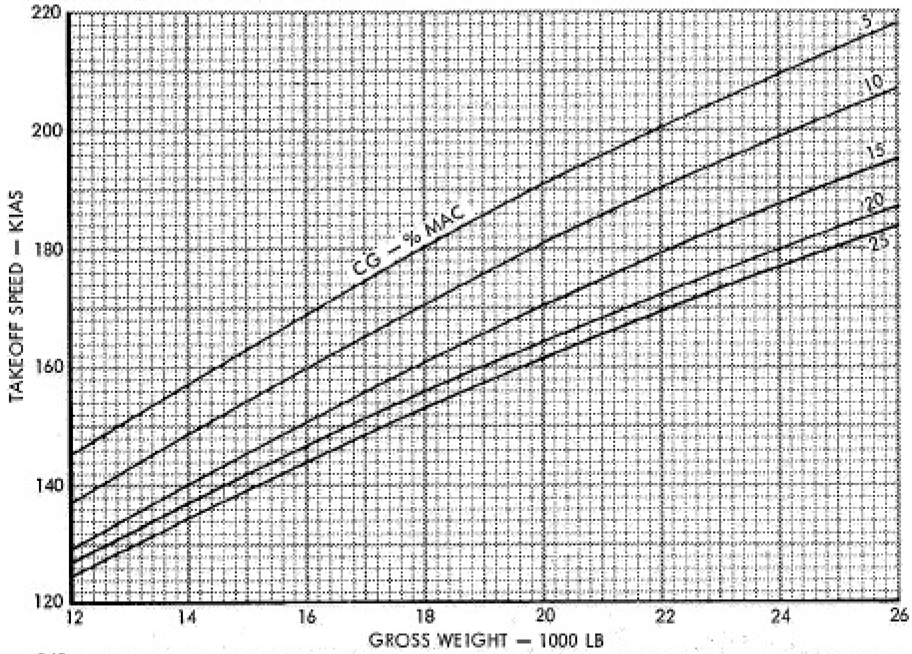
MAXIMUM, MINIMUM AB, OR MILITARY THRUST

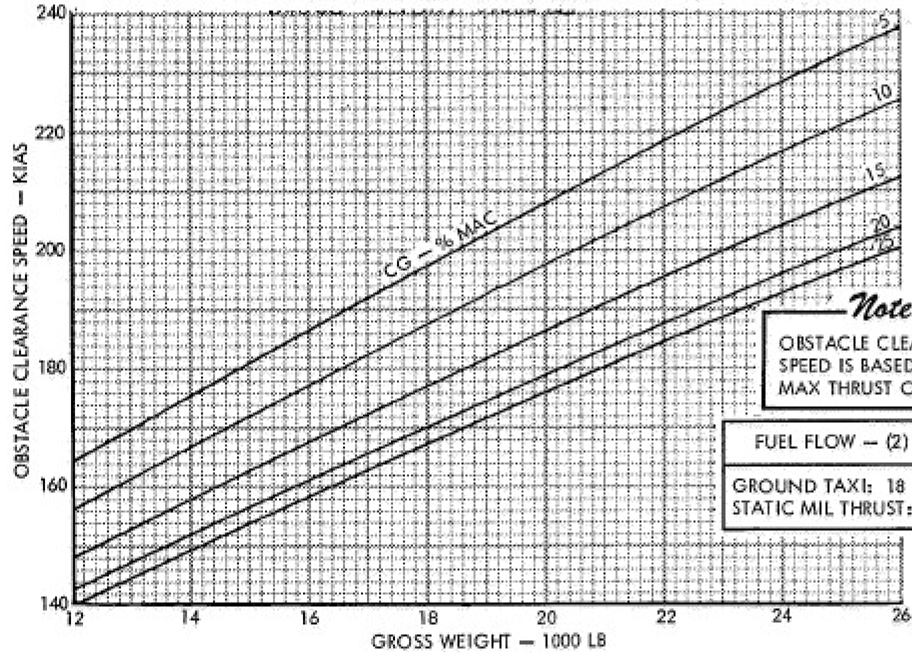
FULL FLAPS



Note

- (F) FOR CONFIGURATIONS WITH CL STORE MORE THAN 1000 LB AND NO WING STORES, INCREASE TAKEOFF SPEED 5 KIAS.
- AFT STICK SPEED IS 10 KNOTS LESS THAN TAKEOFF SPEED.
- SEE TAKEOFF GROUND RUN CHART FOR INCREASED TAKEOFF SPEED CORRECTION REQUIRED FOR HEAVYWEIGHT TAKEOFF WITH TAKEOFF FACTOR 8 OR LESS.





Note

OBSTACLE CLEARANCE SPEED IS BASED ON MAX THRUST ONLY.

FUEL FLOW — (2) ENGINES
GROUND TAXI: 18 LB/MIN STATIC MIL THRUST: 119 LB/MIN

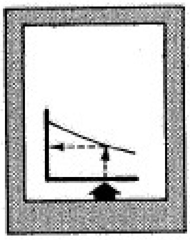
F-5 1-507(20)

FA2-2.

MODEL: F-5E/F
DATE: 1 AUGUST 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2)J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

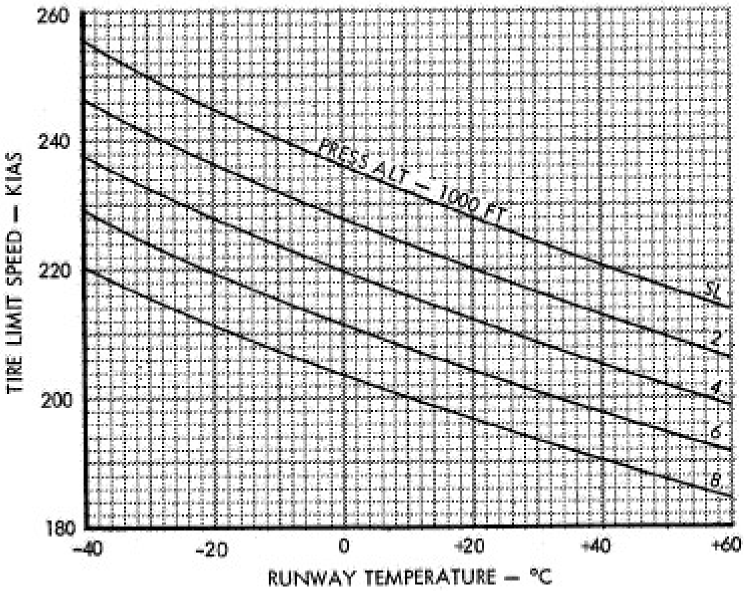
TIRE LIMIT SPEED



Note

- TO CORRECT FOR WIND EFFECT, ADD HEADWIND OR SUBTRACT TAILWIND TO OBTAIN CORRECTED KIAS.
- TIRES MOLD-MARKED 217 KNOTS ARE APPROVED FOR 230 KNOTS.

230 KNOTS GROUND SPEED



F-5 1-506(20)

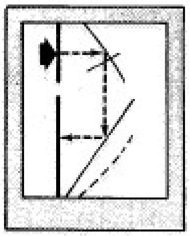
FA2-3.

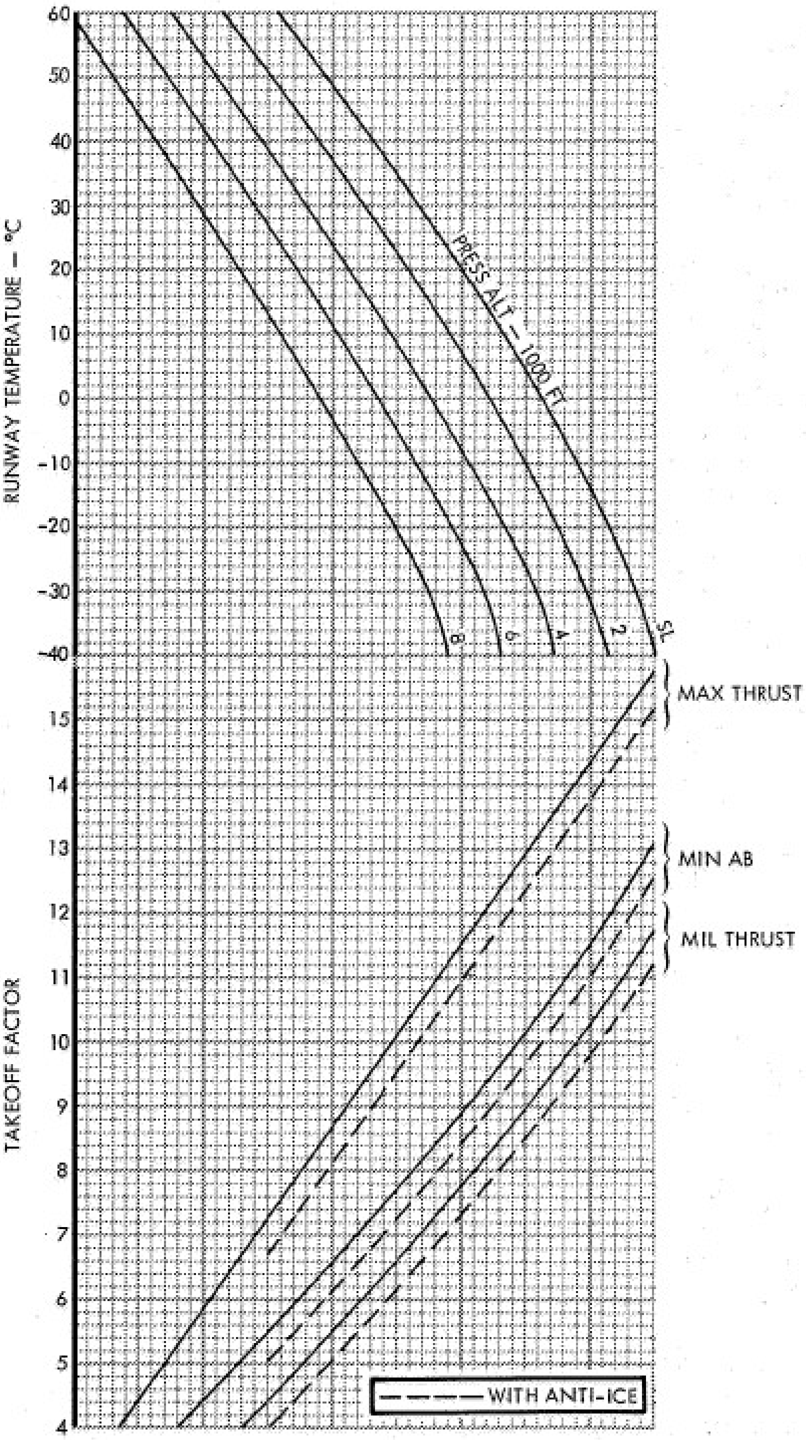
MODEL: F-5E/F
DATE: 1 AUGUST 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

TAKEOFF FACTOR

MAXIMUM, MINIMUM AB, OR MILITARY THRUST





F-5 1-543(20)

FA2-4.

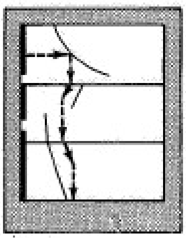
MODEL: F-5E/F
DATE: 1 AUGUST 1976
DATA BASIS: **FLIGHT TEST**

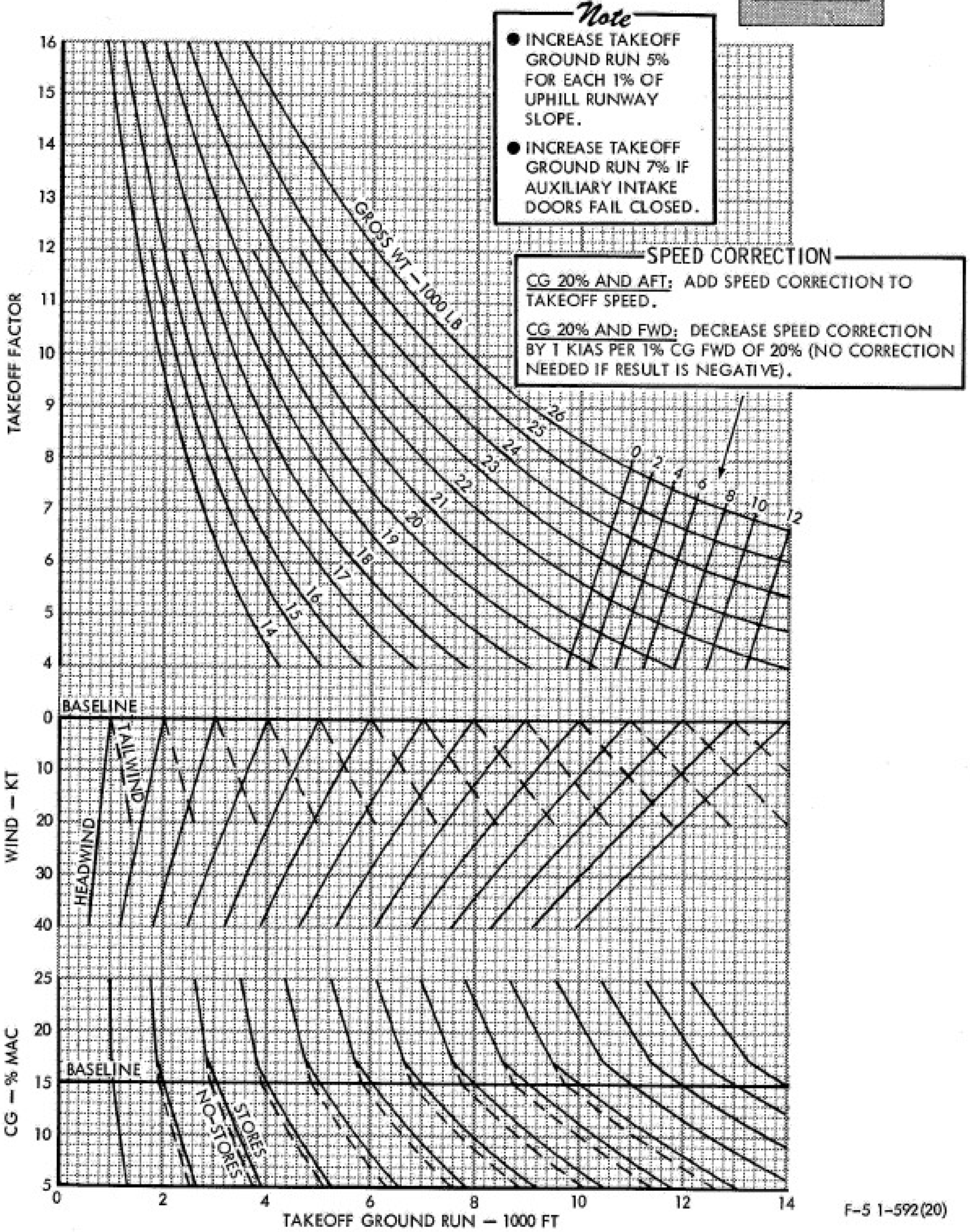
ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

TAKEOFF GROUND RUN

MAXIMUM, MINIMUM AB, OR MILITARY THRUST

FULL FLAPS





F-5 1-592(20)

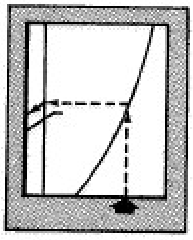
FA2-5.

MODEL: F-5E/F
DATE: 1 AUGUST 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

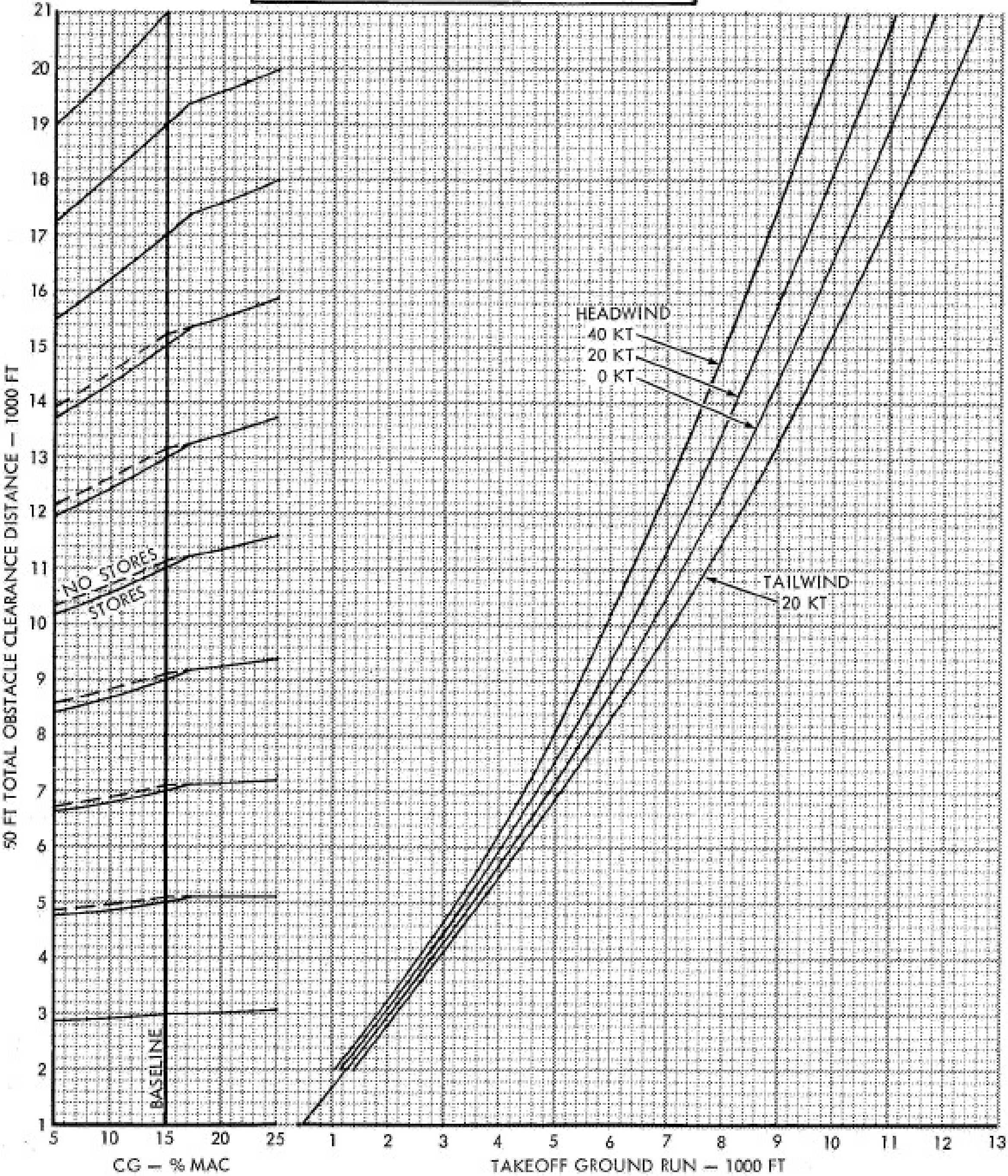
TOTAL OBSTACLE CLEARANCE DISTANCE

MAXIMUM THRUST
FULL FLAPS



Note

ENTER WITH TAKEOFF GROUND RUN CORRECTED FOR WIND, CG, AND RUNWAY SLOPE FROM TAKEOFF GROUND RUN CHART.



FA2-6.

MODEL: F-5E/F
DATE: 1 DECEMBER 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2)J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

MINIMUM SAFE SINGLE-ENGINE TAKEOFF SPEED

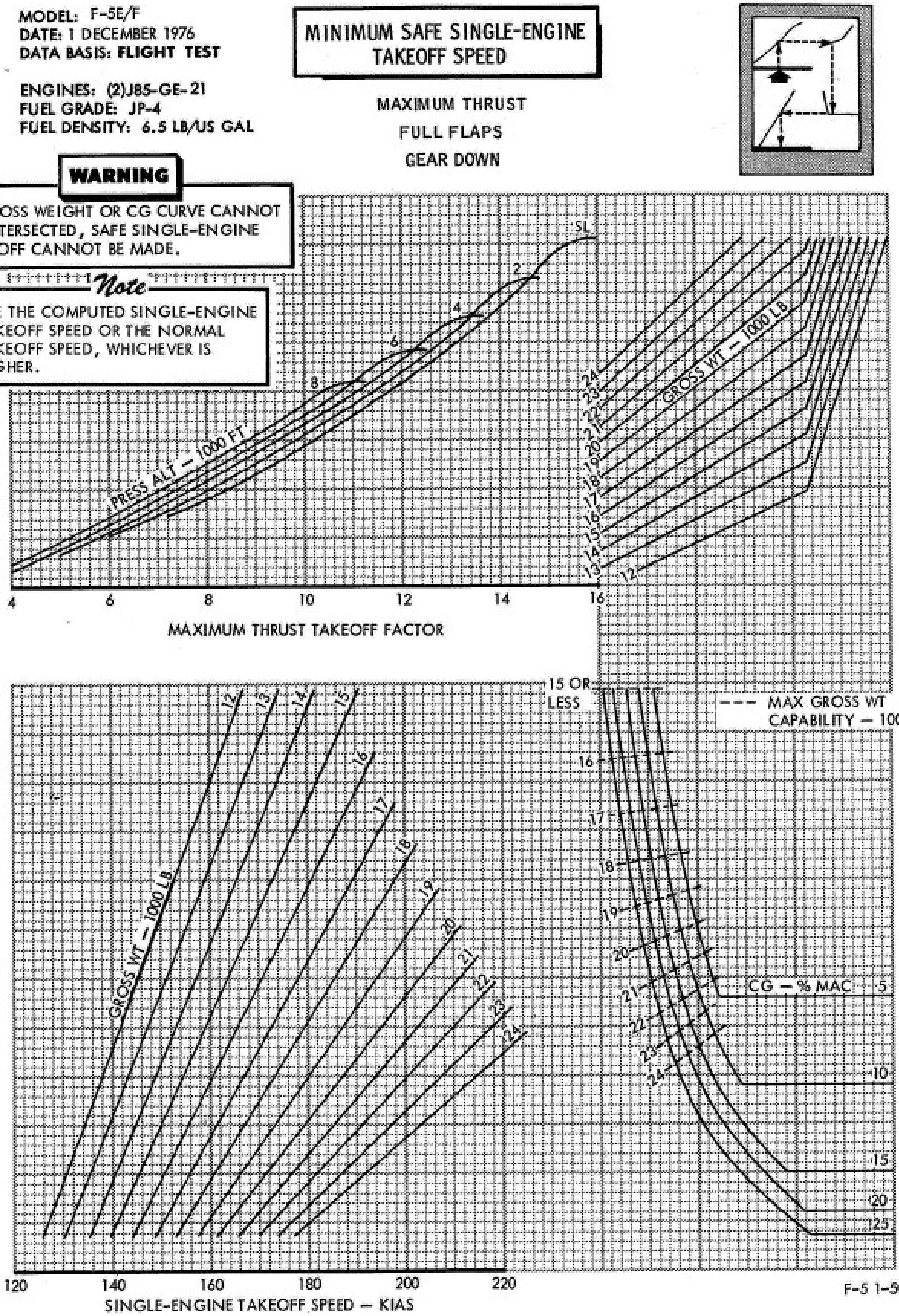
MAXIMUM THRUST
FULL FLAPS
GEAR DOWN

WARNING

IF GROSS WEIGHT OR CG CURVE CANNOT BE INTERSECTED, SAFE SINGLE-ENGINE TAKEOFF CANNOT BE MADE.

Note

USE THE COMPUTED SINGLE-ENGINE TAKEOFF SPEED OR THE NORMAL TAKEOFF SPEED, WHICHEVER IS HIGHER.



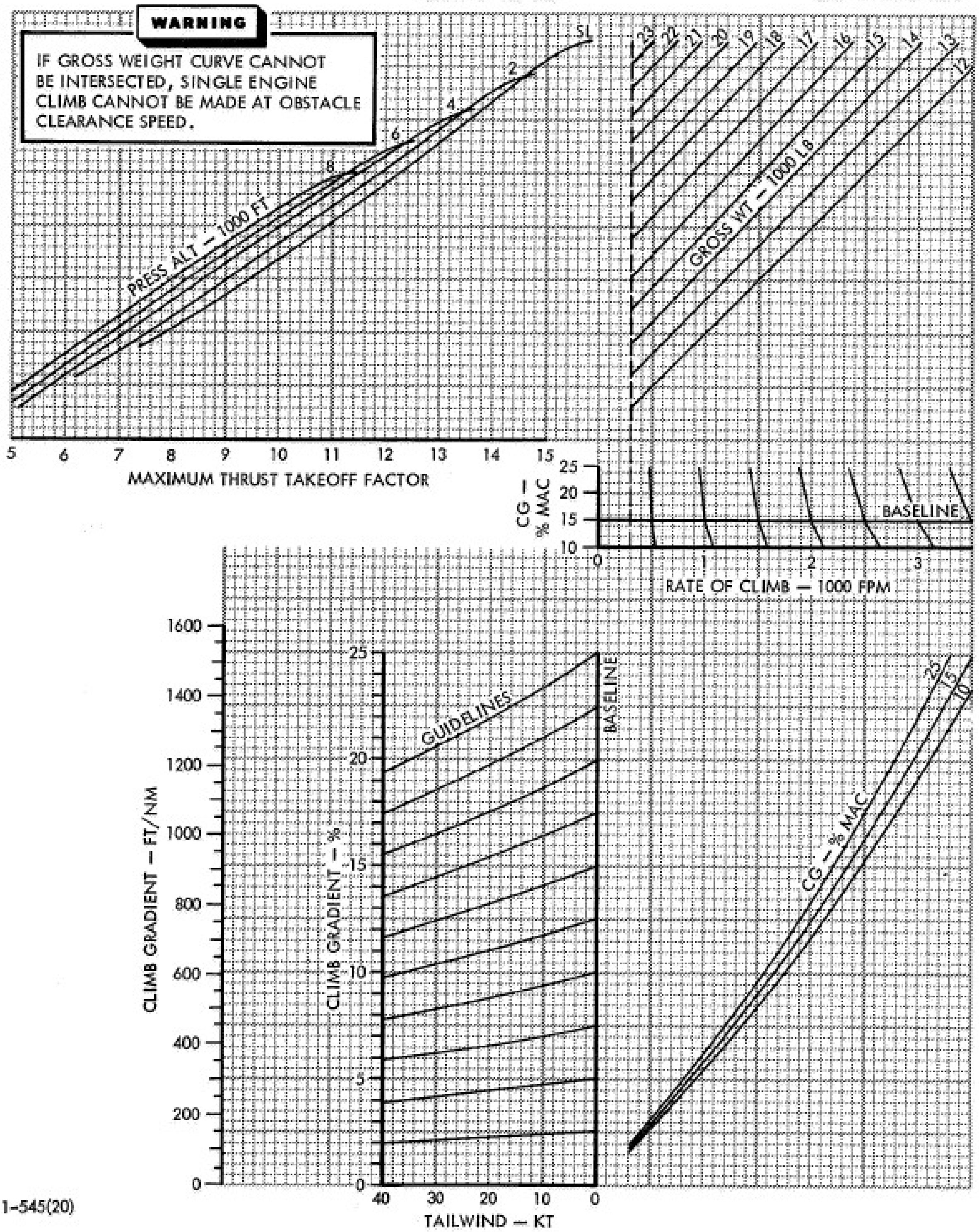
FA2-7.

MODEL: F-5E/F
DATE: 1 DECEMBER 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2)J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

SINGLE-ENGINE CLIMB GRADIENT AT OBSTACLE CLEARANCE SPEED

MAXIMUM THRUST
FULL FLAPS
GEAR DOWN



FA2-8.

MODEL: F-5E/F
DATE: 1 APRIL 1977
DATA BASIS: **FLIGHT TEST**

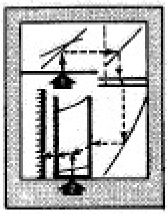
ENGINES: (2)J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

SINGLE-ENGINE CLIMB GRADIENT AT OBSTACLE CLEARANCE SPEED

MAXIMUM THRUST

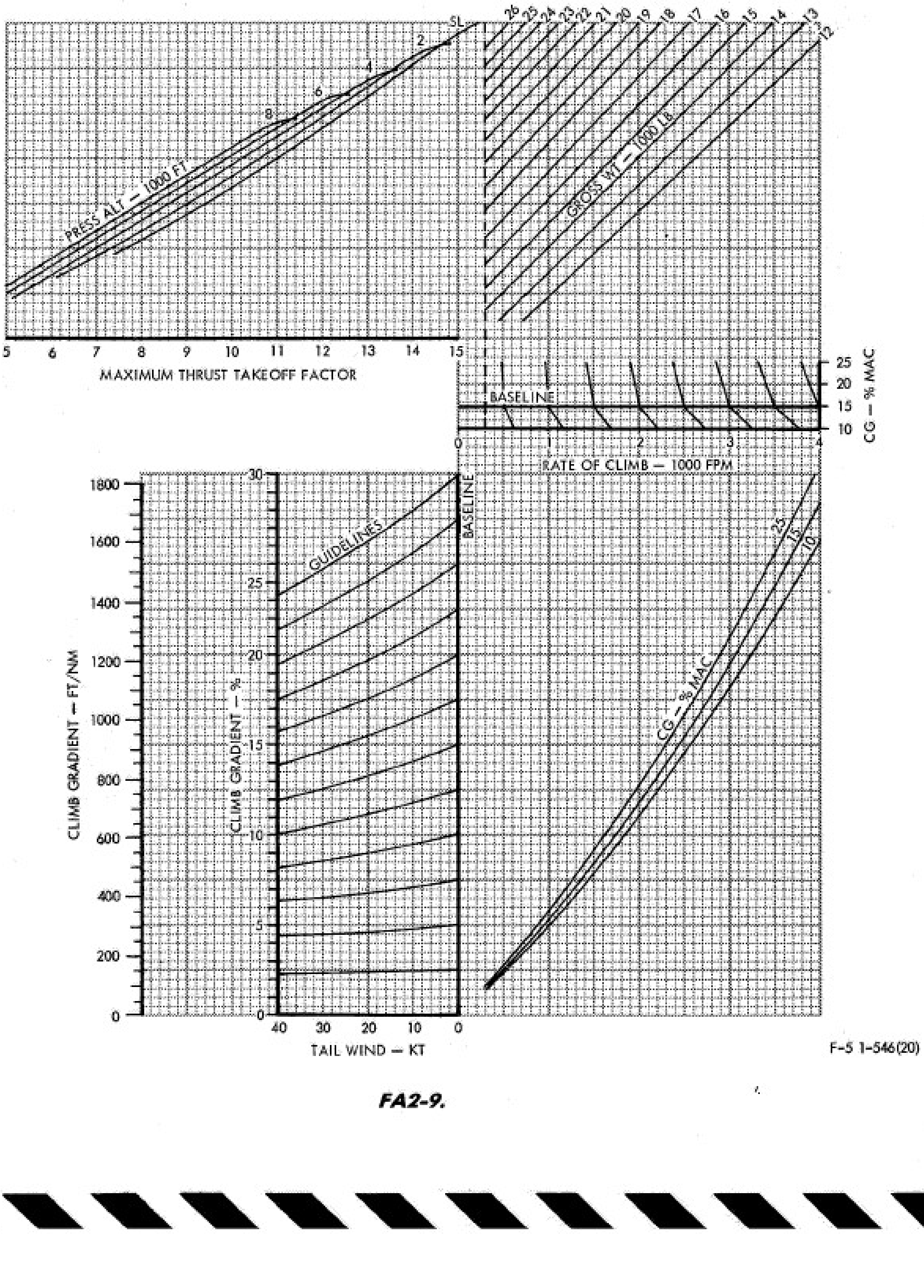
FULL FLAPS

GEAR UP



WARNING

IF GROSS WEIGHT CURVE CANNOT BE INTERSECTED, SINGLE ENGINE CLIMB CANNOT BE MADE AT OBSTACLE CLEARANCE SPEED.



F-5 1-546(20)

FA2-9.

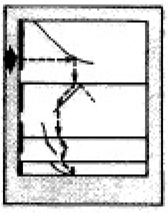
MODEL: F-5E/F
DATE: 1 DECEMBER 1976
DATA BASIS: **FLIGHT TEST**

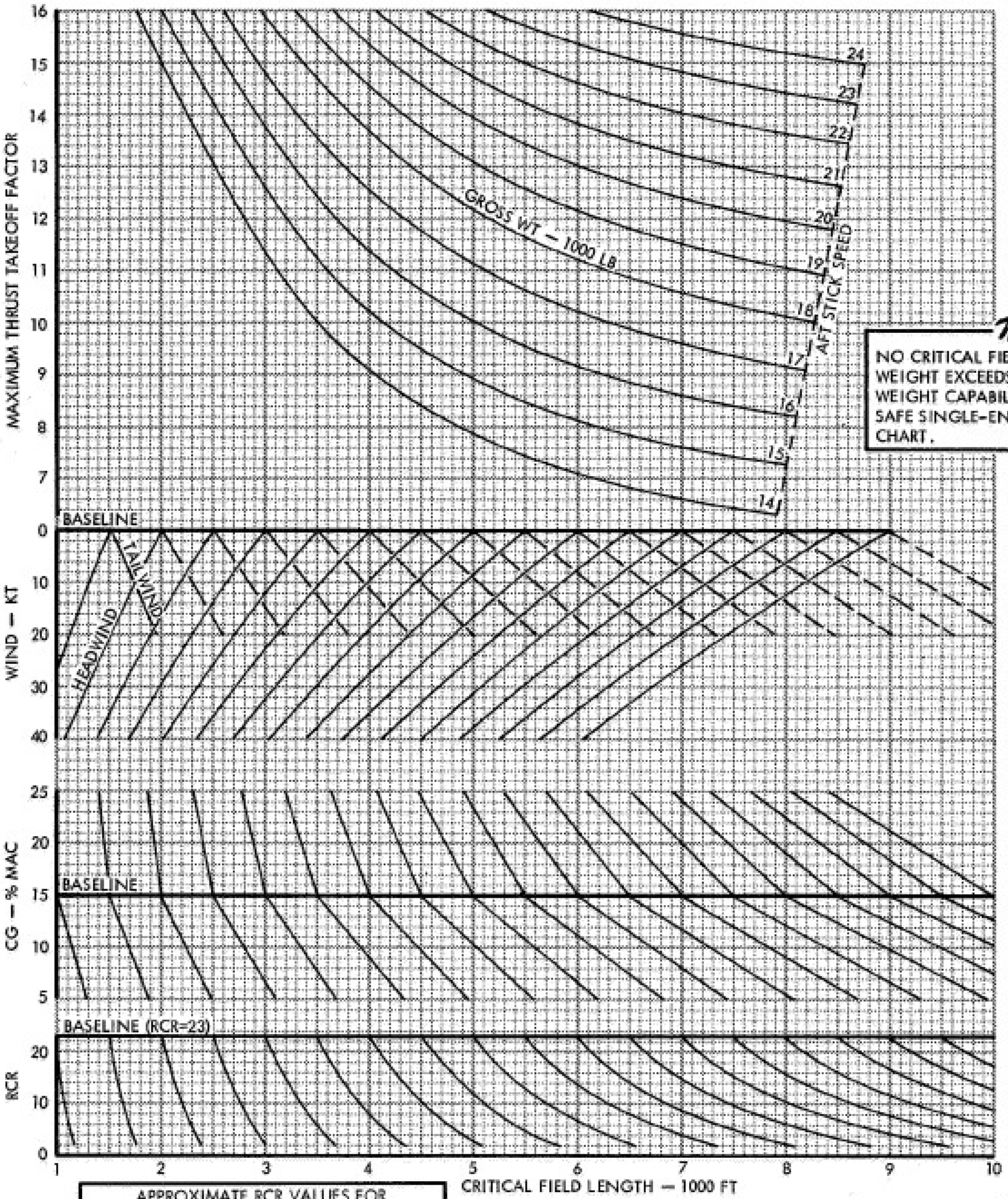
ENGINES: (2)J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

CRITICAL FIELD LENGTH

MAXIMUM THRUST
FULL FLAPS

NO DRAG CHUTE





Note

NO CRITICAL FIELD LENGTH IF GROSS WEIGHT EXCEEDS MAXIMUM GROSS WEIGHT CAPABILITY FROM MINIMUM SAFE SINGLE-ENGINE TAKEOFF SPEED CHART.

APPROXIMATE RCR VALUES FOR HARD-SURFACED RUNWAY CONDITIONS	
CONDITION	RCR
DRY	23
WET	12
WET (STANDING WATER)	7
ICY	5
ICY (GLAZED)	2

Note

INCREASE CRITICAL FIELD LENGTH 5% FOR EACH 1% OF UPHILL RUNWAY SLOPE.

F-5 1-547(20)

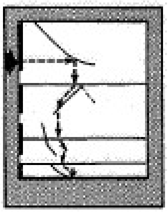
FA2-10.

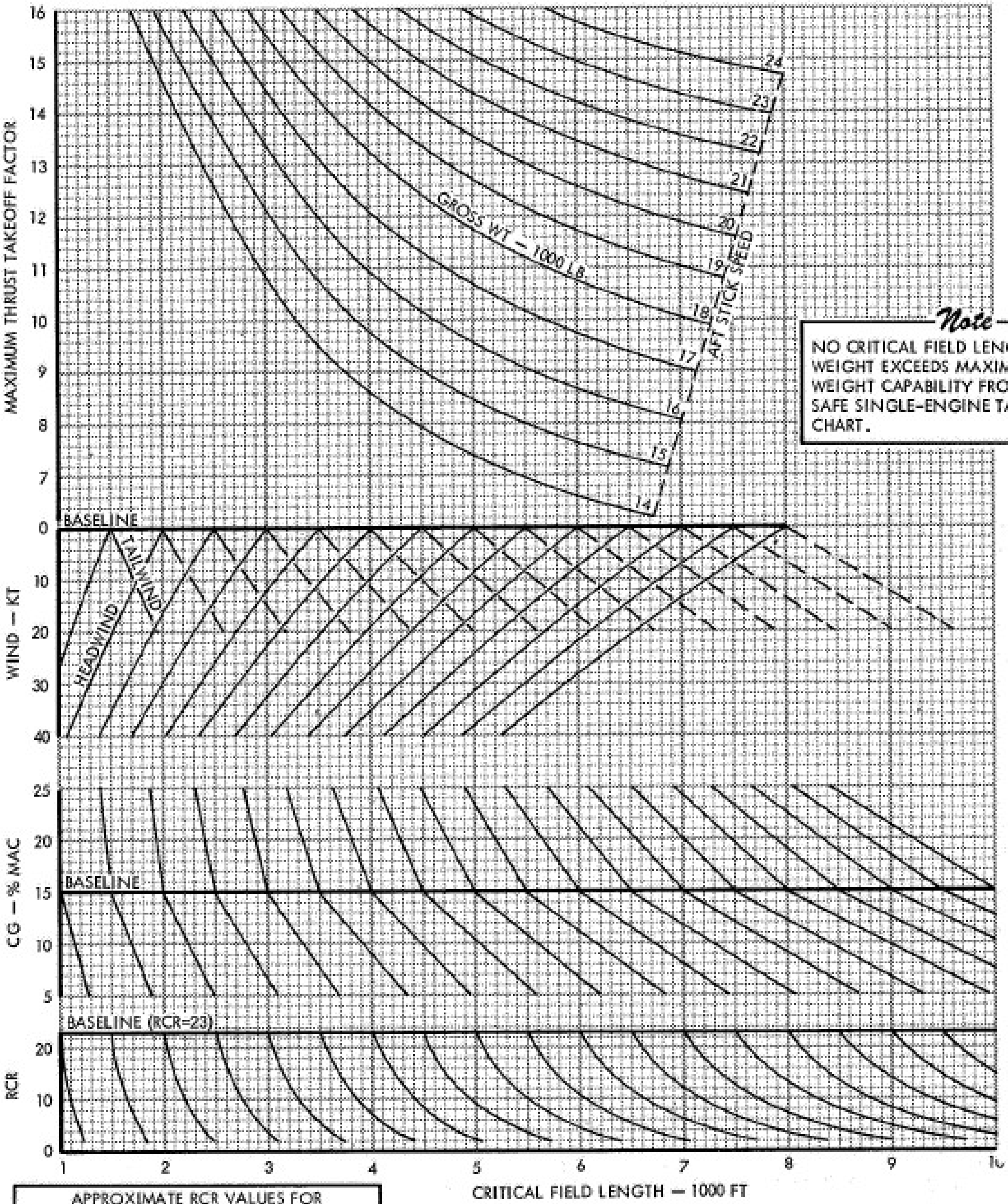
MODEL: F-5E/F
DATE: 1 DECEMBER 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

CRITICAL FIELD LENGTH

MAXIMUM THRUST
FULL FLAPS
WITH DRAG CHUTE





Note

NO CRITICAL FIELD LENGTH IF GROSS WEIGHT EXCEEDS MAXIMUM GROSS WEIGHT CAPABILITY FROM MINIMUM SAFE SINGLE-ENGINE TAKEOFF SPEED CHART.

APPROXIMATE RCR VALUES FOR HARD-SURFACED RUNWAY CONDITIONS	
CONDITION	RCR
DRY	23
WET	12
WET (STANDING WATER)	7
ICY	5
ICY (GLAZED)	2

Note

INCREASE CRITICAL FIELD LENGTH 5% FOR EACH 1% OF UPHILL RUNWAY SLOPE.

F-5 1-548(20)

FA2-11.

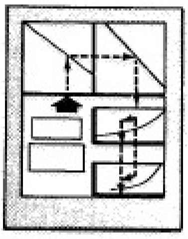
MODEL: F-5E/F
DATE: 1 DECEMBER 1976
DATA BASIS: **FLIGHT TEST**

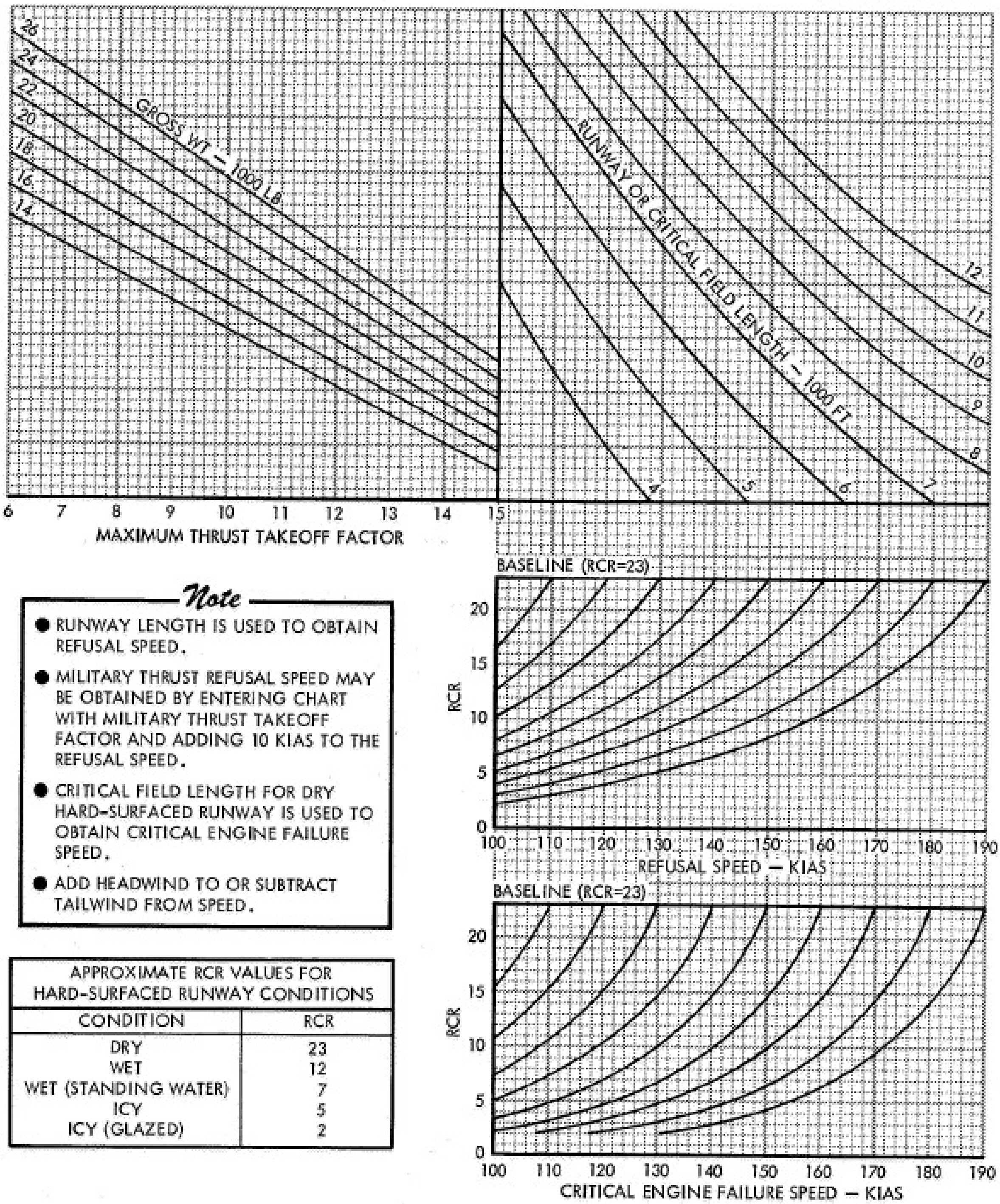
ENGINES: (2)J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

CRITICAL ENGINE FAILURE OR REFUSAL SPEED

MAXIMUM THRUST
FULL FLAPS

NO DRAG CHUTE





Note

- RUNWAY LENGTH IS USED TO OBTAIN REFUSAL SPEED.
- MILITARY THRUST REFUSAL SPEED MAY BE OBTAINED BY ENTERING CHART WITH MILITARY THRUST TAKEOFF FACTOR AND ADDING 10 KIAS TO THE REFUSAL SPEED.
- CRITICAL FIELD LENGTH FOR DRY HARD-SURFACED RUNWAY IS USED TO OBTAIN CRITICAL ENGINE FAILURE SPEED.
- ADD HEADWIND TO OR SUBTRACT TAILWIND FROM SPEED.

APPROXIMATE RCR VALUES FOR HARD-SURFACED RUNWAY CONDITIONS	
CONDITION	RCR
DRY	23
WET	12
WET (STANDING WATER)	7
ICY	5
ICY (GLAZED)	2

F-5 1-549(20)A

FA2-12.

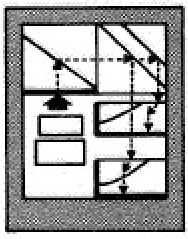
MODEL: F-5E/F
DATE: 1 DECEMBER 1976
DATA BASIS: **FLIGHT TEST**

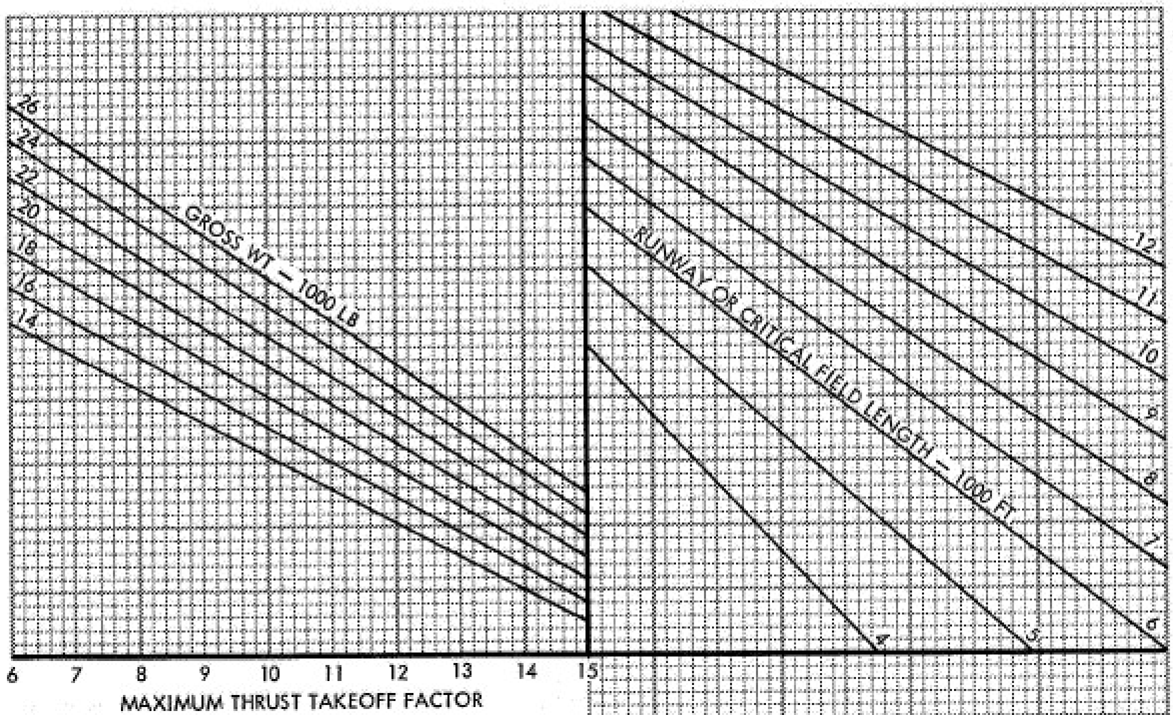
ENGINES: (2)J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

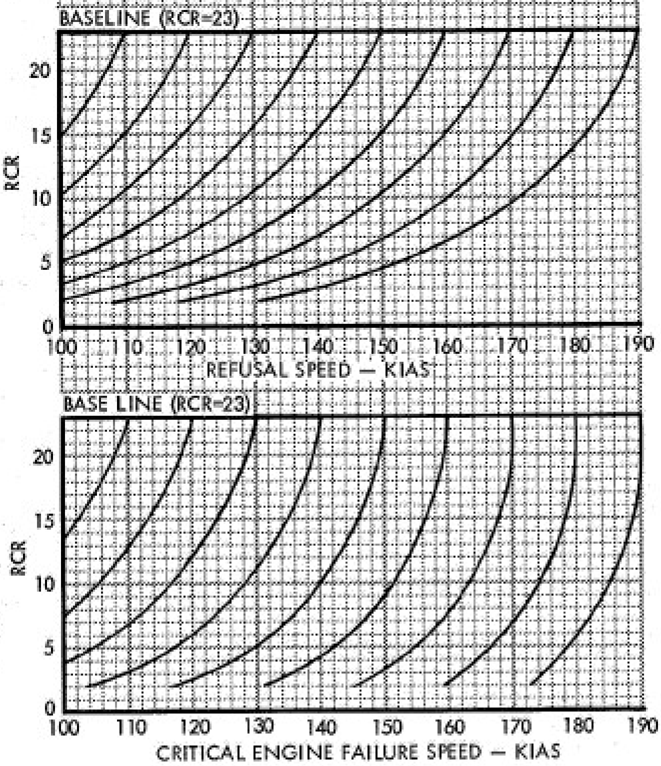
CRITICAL ENGINE FAILURE OR REFUSAL SPEED

MAXIMUM THRUST
FULL FLAPS

WITH DRAG CHUTE







Note

- RUNWAY LENGTH USED TO OBTAIN REFUSAL SPEED.
- CRITICAL FIELD LENGTH FOR DRY HARD-SURFACED RUNWAY IS USED TO OBTAIN CRITICAL ENGINE FAILURE SPEED.
- ADD HEADWIND TO OR SUBTRACT TAILWIND FROM SPEED.

APPROXIMATE RCR VALUES FOR HARD-SURFACED RUNWAY CONDITIONS	
CONDITION	RCR
DRY	23
WET	12
WET (STANDING WATER)	7
ICY	5
ICY (GLAZED)	2

F-5 1-550(20)

FA2-13.

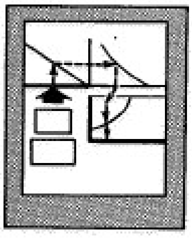
MODEL: F-5E
DATE: 1 APRIL 1978
DATA BASIS: **FLIGHT TEST**

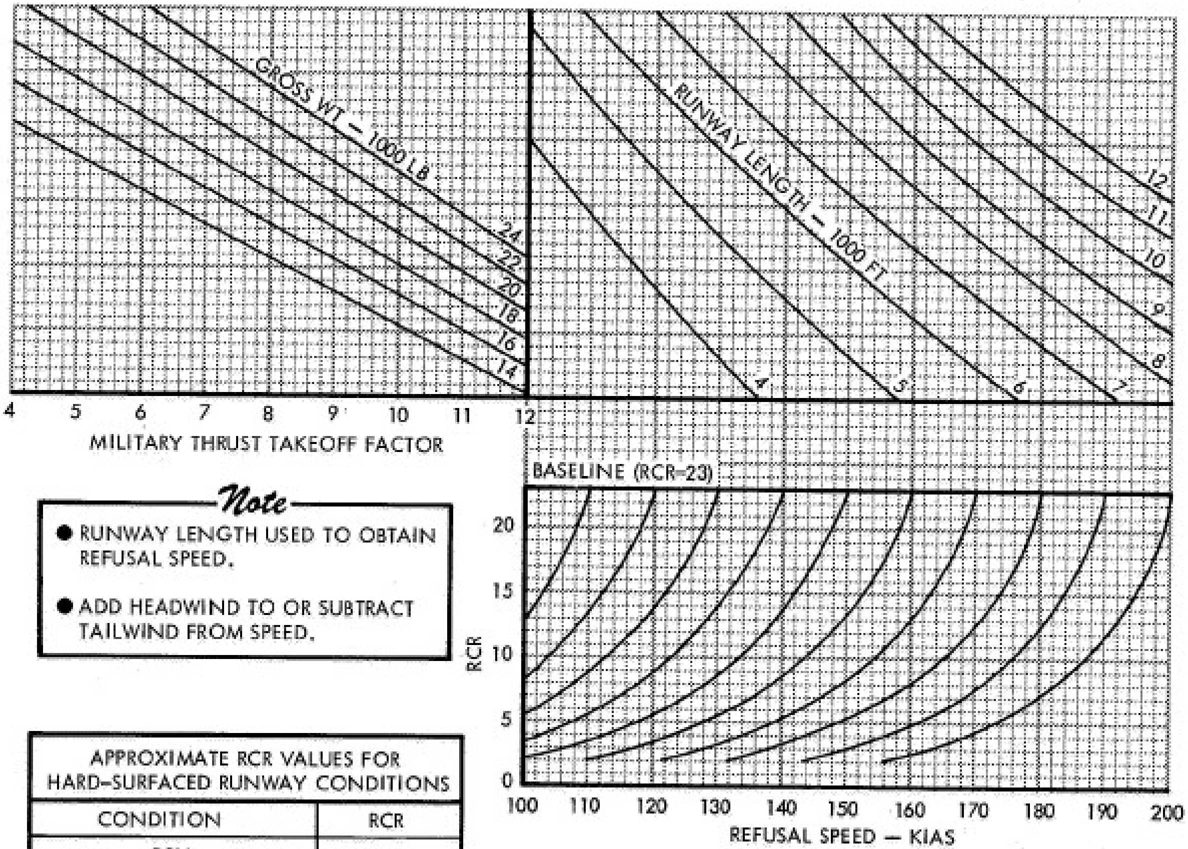
ENGINES: (2)J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

REFUSAL SPEED

MILITARY THRUST
FULL FLAPS

WITH DRAG CHUTE





Note

- RUNWAY LENGTH USED TO OBTAIN REFUSAL SPEED.
- ADD HEADWIND TO OR SUBTRACT TAILWIND FROM SPEED.

APPROXIMATE RCR VALUES FOR HARD-SURFACED RUNWAY CONDITIONS

CONDITION	RCR
DRY	23
WET	12
WET (STANDING WATER)	7
ICY	5
ICY (GLAZED)	2

F-5 1-683(1)

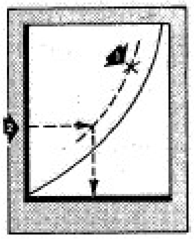
FA2-14.

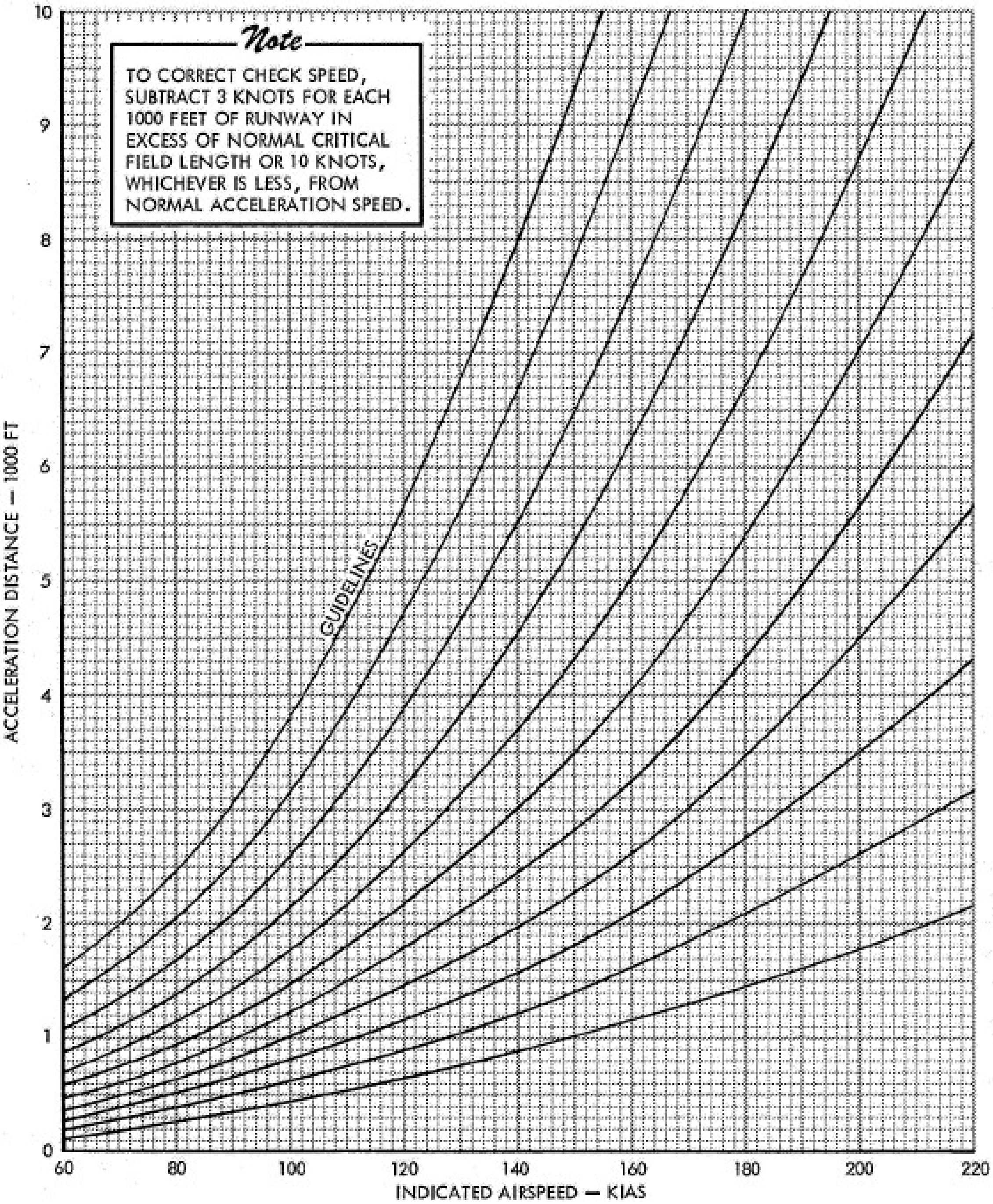
MODEL: F-5E/F
DATE: 1 DECEMBER 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

VELOCITY DURING TAKEOFF GROUND RUN

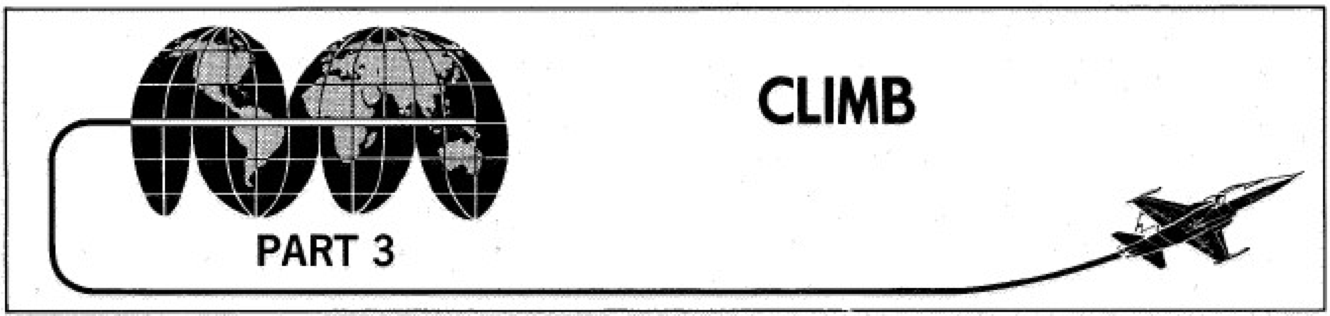
MAXIMUM, MINIMUM AB, OR MILITARY THRUST
DRY, HARD-SURFACED RUNWAY
FULL FLAPS





F-5 1-568(20) B

FA2-15.



F-5 1-98(1)

TABLE OF CONTENTS

Page numbers underlined denote charts.

CLIMB CHARTS (GENERAL)

Climb charts provide aircraft climb performance, including time, distance, and fuel required to climb for various drag indexes. The time, distance, and fuel required to climb from sea level to altitude are presented for all gross weights and drag indexes of 0 to 400 for both maximum and military thrust. The climb speed schedules are based on providing minimum time to climb with maximum thrust and maximum range with military thrust. Data for single-engine maximum thrust climb for drag indexes of 0 to 120 are also provided. The single-engine climb speed schedules are based on providing maximum range with maximum thrust.

TIME, FUEL, AND DISTANCE FROM BRAKE RELEASE TO CLIMB SPEED CHART

The Time, Fuel, and Distance from Brake Release to Climb Speed chart (FA3-1) presents the time, fuel and distance required to take off and accelerate to best climb speed. The data on the left side of the chart are based on taking off and accelerating with maximum thrust to the climb speed schedule for a maximum thrust climb. The data on the right side of the chart are based on taking off with maximum thrust and accelerating with maximum thrust to 300 KIAS, then continuing with military thrust acceleration to the climb speed schedule for a military thrust climb. Less time, distance, and fuel are required for the higher drag index because the climb speeds are lower. The climb speed schedules are tabulated on sheet 1 of the climb performance charts. Fuel flow values for ground taxi (idle rpm) and static military thrust runup conditions are shown at the bottom of the chart. The fuel estimated for ground operation (taxi and runup) plus the fuel required to take off and accelerate to climb speed are subtracted from the aircraft takeoff gross weight to obtain the gross weight at the start of initial climb.

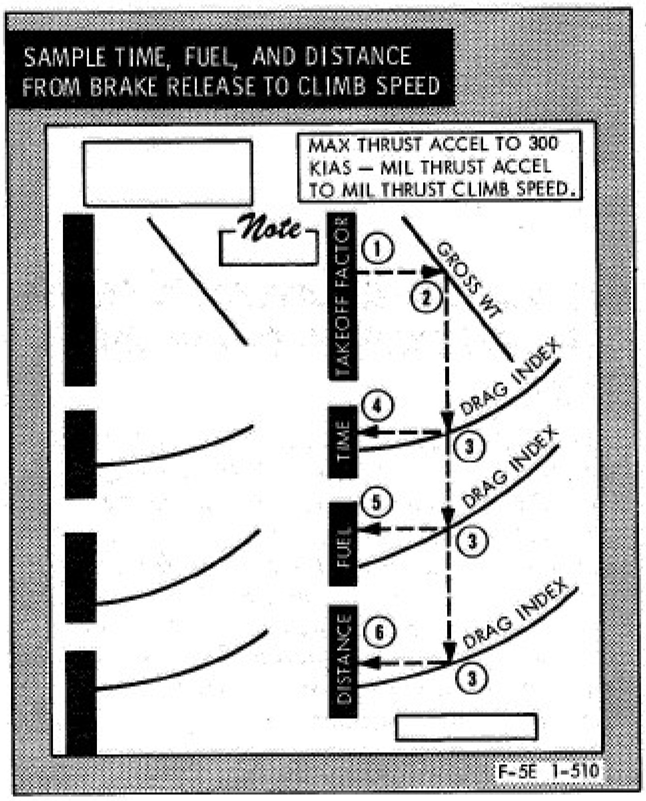
USE

Enter appropriate acceleration portion of FA3-1 with takeoff factor and proceed right to the gross weight at start of takeoff. At the point of intersection with the weight curve (interpolate as necessary), project down thru all the drag index curves of the time, fuel, and distance scales. At each point of intersection with the desired drag index, proceed left and read time, fuel, and distance, respectively.

SAMPLE PROBLEM

Given:

A. Takeoff factor: 11.6.
B. Takeoff gross weight (with stores): 20,300 lb.
C. Configuration drag index: 120.



Calculate:

A. Time, fuel, and distance required for maximum thrust takeoff and acceleration to 300 KIAS, then military thrust acceleration to best military thrust climb speed schedule.
B. Use Time, Fuel, and Distance from Brake Release to Climb Speed chart FA3-1.

(1)	Takeoff Factor (max thrust)	11.6
(2)	Gross Wt	20,290 lb
(3)	Drag Index	120
(4)	Time	1.1 min
(5)	Fuel	310 lb
(6)	Distance	3 nm

MAXIMUM AND MILITARY THRUST CLIMB CHARTS

The charts for Maximum Thrust Climb are contained in FA3-2 thru FA3-3; those for Military Thrust Climb are contained in FA3-4 thru FA3-5. Maximum Thrust Climb for single-engine is contained in FA3-6. Each Climb Chart consists of two sheets. Sheet 1 is used to find fuel used as a function of sea level gross weight, pressure altitude, drag index, and temperature. Sheet 2 is used to find time to climb and distance traveled as a function of sea level gross weight, pressure altitude, drag index, and temperature. The temperature correction scale on each sheet of the charts corrects for non-standard day conditions.

The recommended climb schedule for various drag indexes is shown in tabular form on each sheet 1 of the maximum and military thrust climb charts. The maximum thrust with two engines charts provide the minimum time to climb; the military thrust with two engines and the maximum thrust with single engine charts provide the minimum fuel to climb. The constant KIAS climb speed portion of the schedule provides an increasing mach number to the airspeed transition altitude (KIAS to altitude). At the airspeed transition altitude, climb speed is then established at a constant mach number, which is maintained until desired cruise altitude is reached (IMN to level-off). Use 0°/0° flaps for climb with maximum or military thrust.

If the climb starts at sea level, enter the climb performance with sea level gross weight and move to the right to the end climb altitude, then down to the drag index value, and left to the temperature baseline. Continue thru the temperature correction grid if standard day temperature is used. If a temperature correction is required, contour the nearest guideline to the desired temperature variation, then proceed left to the fuel, time, or distance scale and read the value.

If the climb begins at an altitude other than sea level, the fuel required to climb from one altitude to another is the fuel required from sea level to the higher altitude less the fuel required from sea level to the lower altitude. Time and distance are found in the same manner.

The fuel, time, and distance values should be read for a gross weight adjusted to sea level for the purpose of entering the climb charts. This weight is heavier than the start climb gross weight by the amount of fuel required to climb from sea level to the start climb altitude. To determine the adjusted sea level gross weight, enter the sea level gross weight scale of the appropriate climb chart with the aircraft weight at the start climb altitude and read the fuel used for this gross weight. Add this value to the start climb gross weight at altitude to obtain the adjusted sea level gross weight.

USE

Enter sheet 1 with the sea level gross weight and proceed right to the pressure altitude. Proceed down to the drag index and then left to the baseline of the temperature scale. If temperature is standard, proceed across; if not, contour the guideline for hotter or colder temperature variation and then proceed across to read fuel used.

Enter sheet 2 with the sea level gross weight and move right to the pressure altitude. Proceed down thru the drag index of the time portion of the chart and continue down to the drag index of the distance portion of the chart. At each point of intersection of the drag index, project left and read time and distance, respectively.

SAMPLE PROBLEM

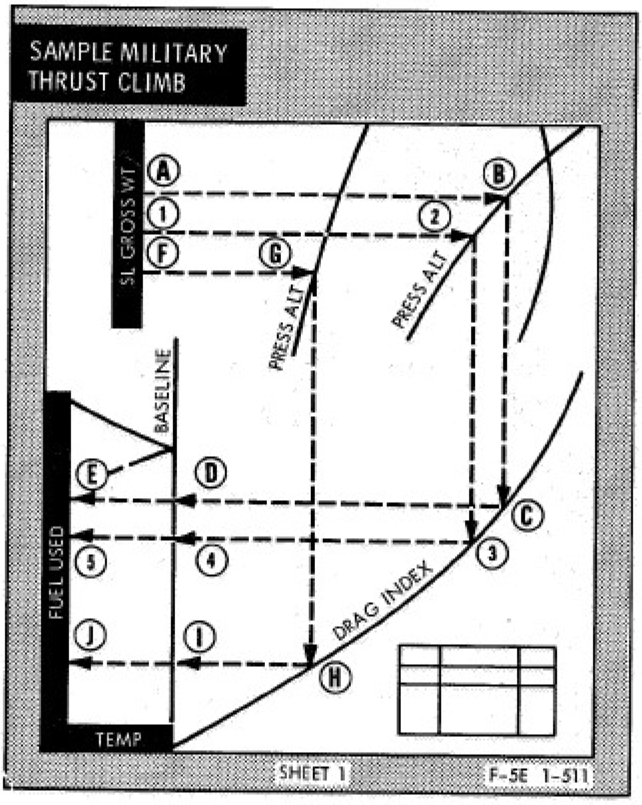
Given:

A. Takeoff field elevation (above sea level): 1000 ft.
B. Start climb gross weight: 19,980 lb.
C. Military thrust climb to: 30,000 ft.
D. Configuration drag index: 120.
E. Standard day temperature at all altitudes.

Calculate:

A. Fuel, time, and distance required for a climb from 1000 ft field elevation to 30,000 ft pressure altitude.
B. Use Military Thrust Climb, Fuel Used, Drag Index 0 to 200 chart FA3-4, sheet 1.

①	Start Climb Gross Wt	19,980 lb
②	Press Alt (field elevation)	1000 ft
③	Drag Index	120



④	Baseline (std day temp)	———
⑤	Fuel Used	35 lb

C. Since the climb begins at an altitude other than sea level (chart data based on sea level conditions), determine adjusted "sea level gross weight."

D. Start Climb Gross Weight (at field elevation) + Fuel Used = Adjusted "Sea Level Gross Weight."
Thus: 19,980 lb + 35 lb = 20,015 lb

E. Reenter FA3-4, sheet 1, to determine fuel used from sea level to the higher altitude for the adjusted "sea level gross weight."

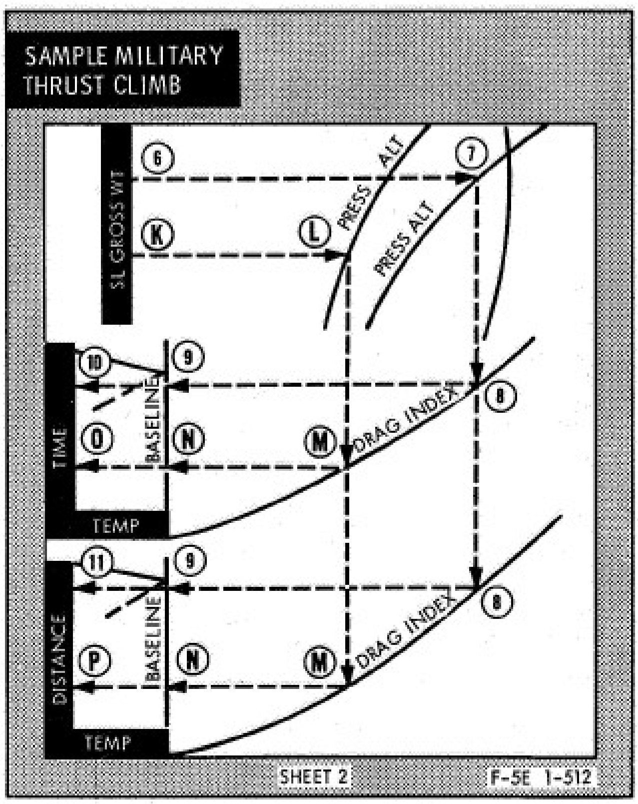
Ⓐ	Adjusted SL Gross Wt	20,015 lb
Ⓑ	Press Alt (cruise alt)	30,000 ft
Ⓒ	Drag Index	120
Ⓓ	Baseline (std day temp)	———
Ⓔ	Fuel Used	1200 lb

F. Reenter FA3-4, sheet 1, to determine fuel used from sea level to the lower altitude for adjusted "sea level gross weight."

Ⓕ	Adjusted SL Gross Wt	20,015 lb
Ⓖ	Press Alt (field elevation)	1000 ft
Ⓗ	Drag Index	120
Ⓘ	Baseline (std day temp)	———
Ⓙ	Fuel Used	35 lb

G. Fuel Used (30,000 ft) − Fuel Used (1000 ft) = Fuel Required to Climb from 1000 to 30,000 ft.
Thus: 1200 lb − 35 lb = 1165 lb

H. Use Military Thrust Climb. Time to Climb and Distance Traveled, Drag Index 0 to 200 chart FA3-4, sheet 2.



I. Using the adjusted sea level gross weight calculated in sheet 1, determine time and distance to climb from sea level to the higher altitude.

⑥ Adjust SL Gross Wt	20,015 lb
⑦ Press Alt	30,000 ft
⑧ Drag Index	120
⑨ Baseline (std day temp)	———
⑩ Time	14.7 min
⑪ Distance	102 nm

J. Reenter FA3-4, sheet 2, to determine time and distance to climb from sea level to the lower altitude.

Ⓚ Adjusted SL Gross Wt	20,015 lb
Ⓛ Press Alt	1000 ft
Ⓜ Drag Index	120
Ⓝ Baseline (std day temp)	———
Ⓞ Time	0.3 min
Ⓟ Distance	2 nm

K. Time (30,000 ft) – Time (1000 ft) = Time Required to Climb from 1000 to 32,000 ft.
Thus: 14.7 min – 0.3 min = 14.4 min

L. Distance (30,000 ft) – Distance (1000 ft) = Distance Required to Climb from 1000 to 30,000 ft.
Thus: 102 nm – 2 nm = 100 nm

COMBAT CEILING CHART

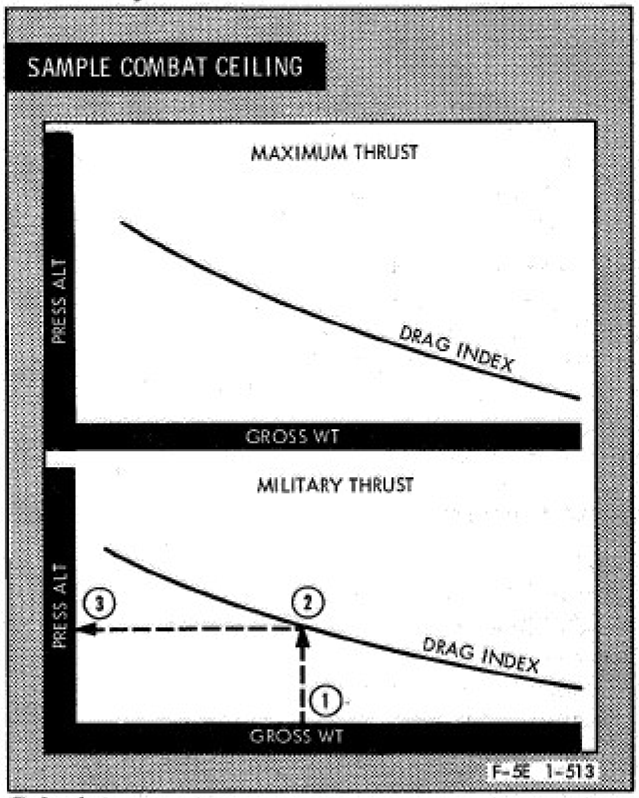
The Combat Ceiling chart (rate of climb = 500 fpm) for maximum and military thrust is presented in FA3-7. The chart determines the combat ceiling for a standard day as a function of gross weight and drag index with flaps up. The combat ceiling is based on the actual gross weight at altitude and use of the appropriate climb speed schedule.

USE

Enter either the maximum thrust or military thrust portion of the chart with gross weight and proceed up to the drag index. From this point move left and read pressure altitude (combat ceiling).

SAMPLE PROBLEM

Given:
A. Gross weight (at altitude):18,600 lb.
B. Standard day condition at altitude.
C. Drag Index: 120
D. Military thrust.



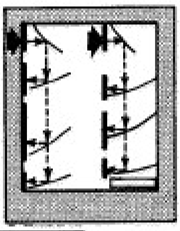
Calculate:
A. Combat ceiling.
B. Use Combat Ceiling, Military Thrust, chart FA3-7.

① Gross Wt	18,600 lb
② Drag Index	120
③ Press Alt	32,000 ft

MODEL: F-5E/F
DATE: 1 MARCH 1978
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

TIME, FUEL, AND DISTANCE FROM BRAKE RELEASE TO CLIMB SPEED

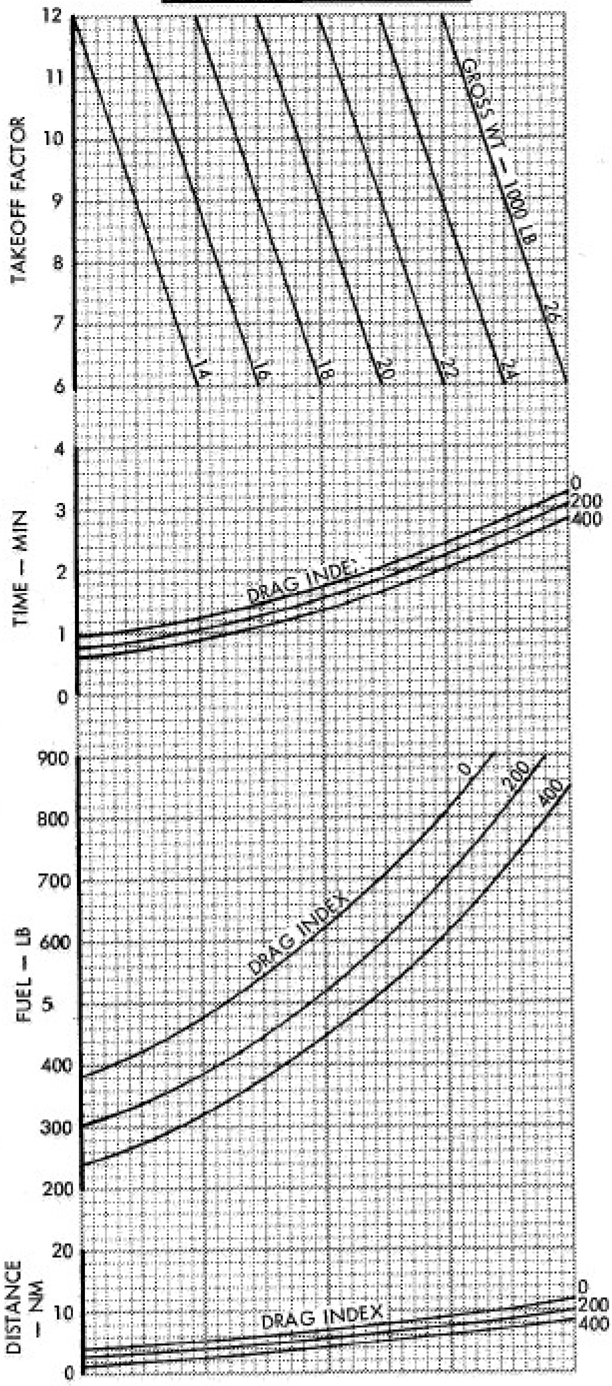


MAXIMUM THRUST TAKEOFF

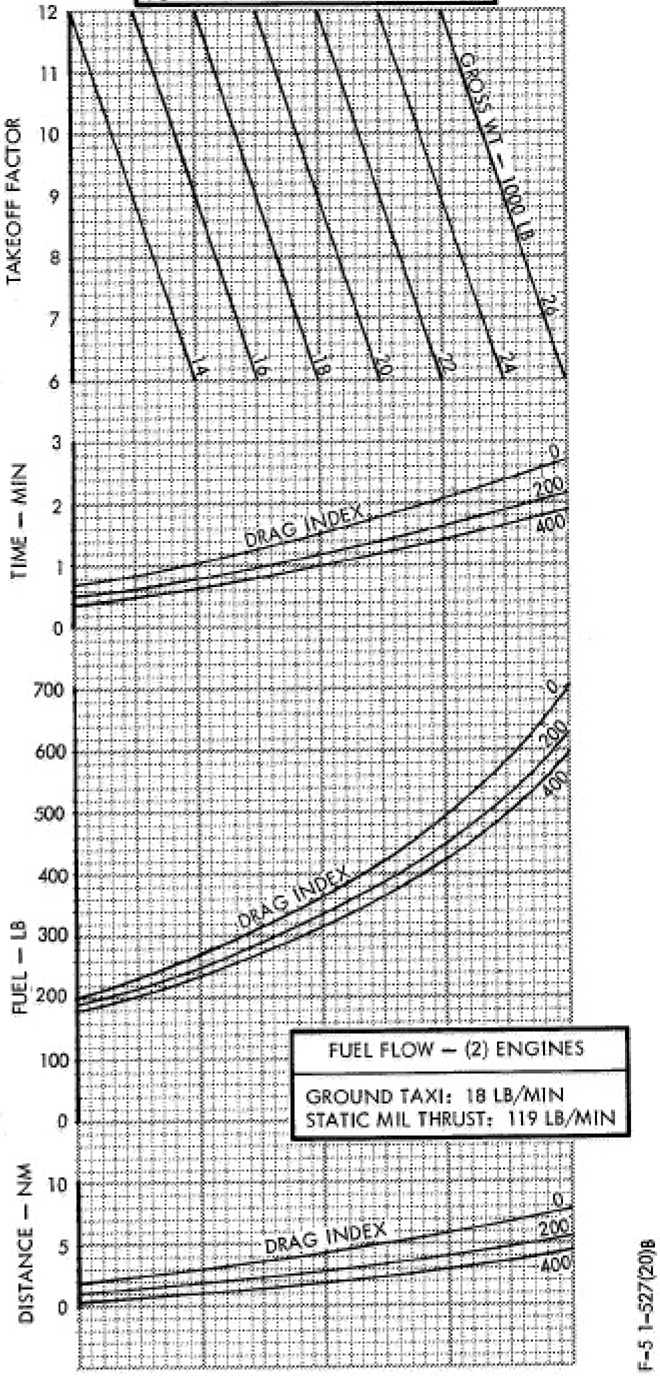
Note

USE TAKEOFF FACTOR 12 FOR ALL TAKEOFF FACTORS ABOVE 12.

MAX THRUST ACCELERATION TO MAX THRUST CLIMB SPEED.



MAX THRUST ACCELERATION TO 300 KIAS — MIL THRUST ACCELERATION TO MIL THRUST CLIMB SPEED.



F-5 1-527(20)B

FA3-1.

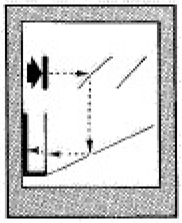
MODEL: F-5E/F
DATE: 1 MARCH 1978
DATA BASIS: **FLIGHT TEST**

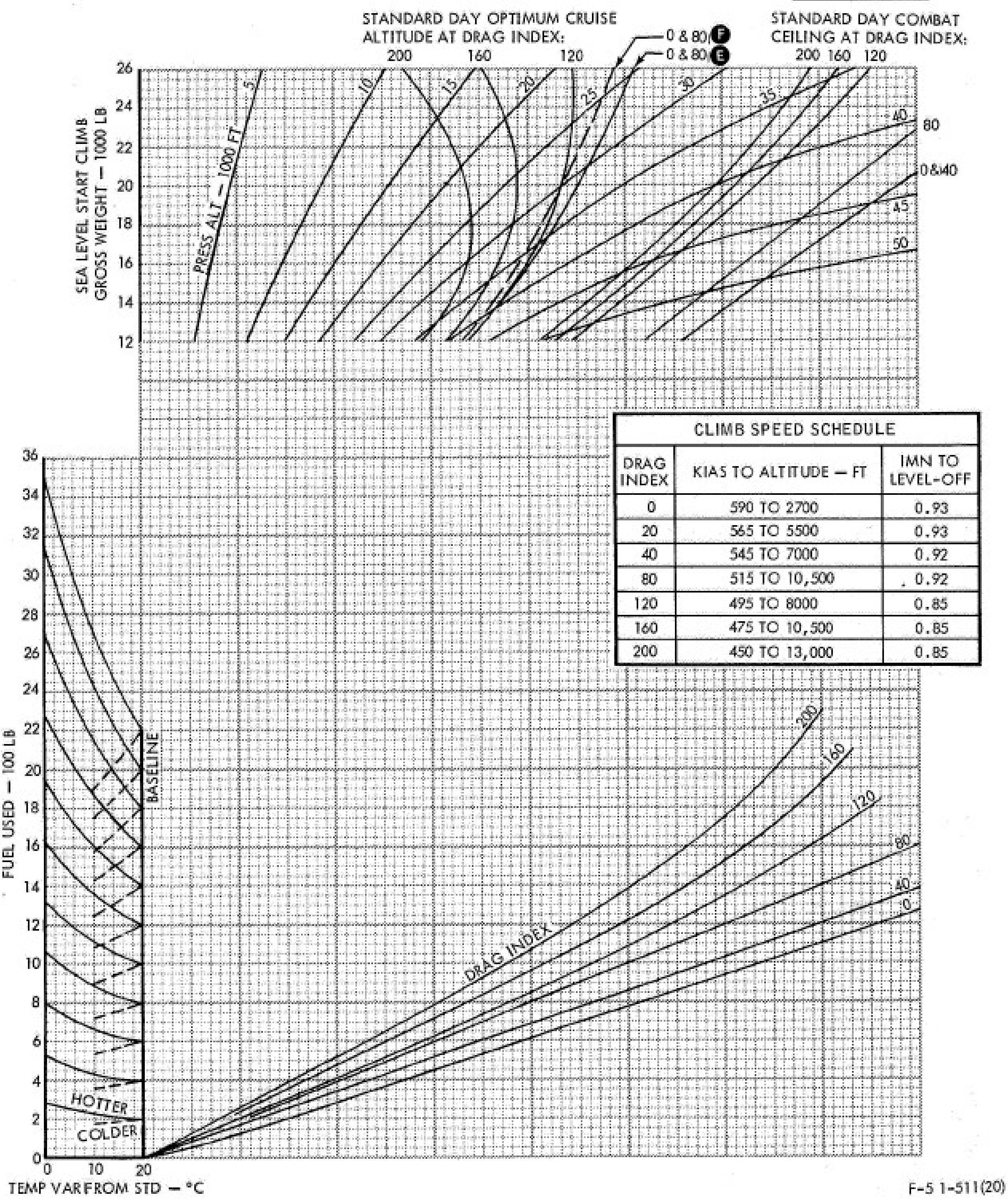
ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

MAXIMUM THRUST CLIMB (FLAPS UP

FUEL USED

DRAG INDEX 0 TO 200





CLIMB SPEED SCHEDULE		
DRAG INDEX	KIAS TO ALTITUDE — FT	IMN TO LEVEL-OFF
0	590 TO 2700	0.93
20	565 TO 5500	0.93
40	545 TO 7000	0.92
80	515 TO 10,500	0.92
120	495 TO 8000	0.85
160	475 TO 10,500	0.85
200	450 TO 13,000	0.85

FA3-2 (Sheet 1).

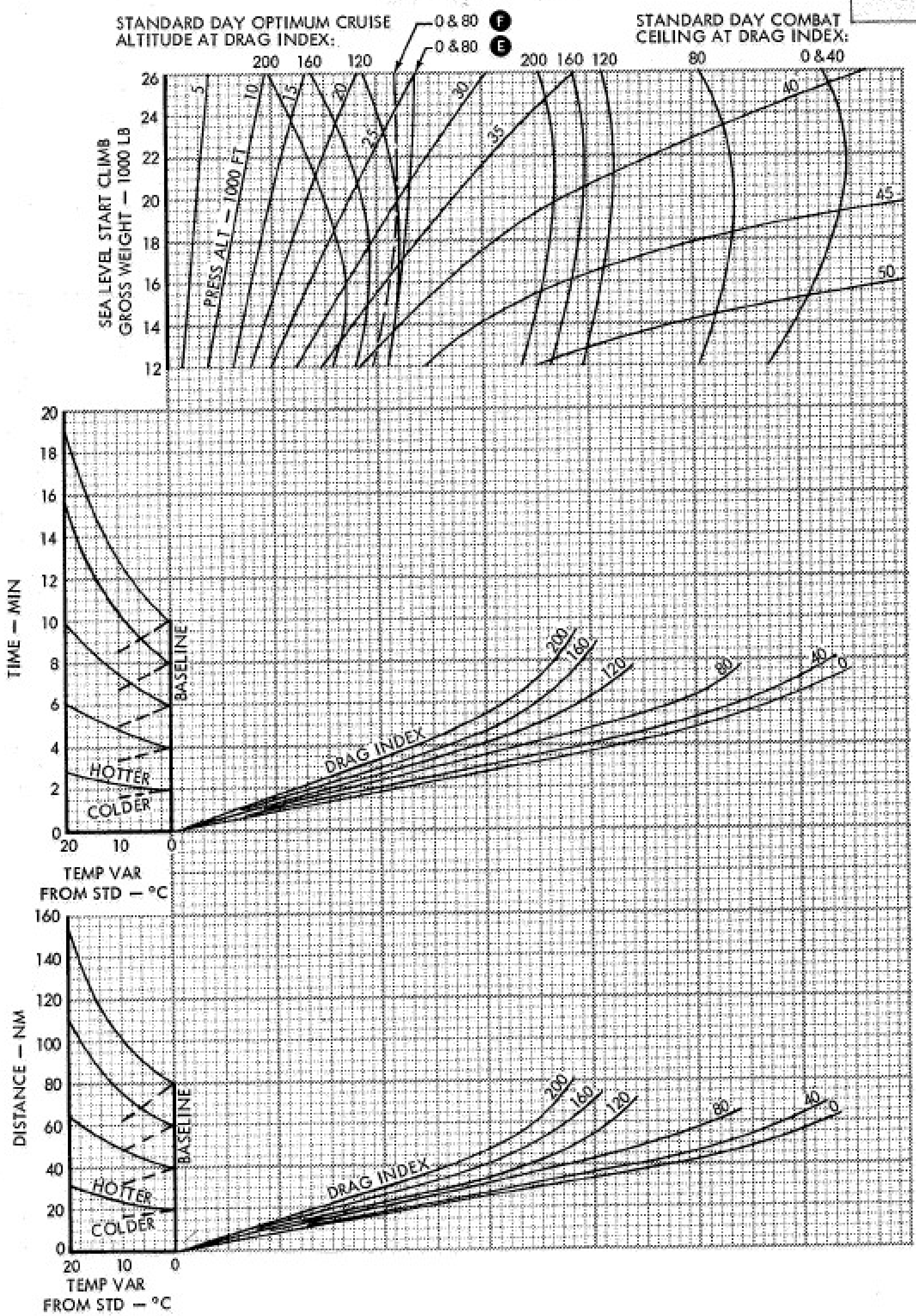
MODEL: F-5E/F
DATE: 1 MARCH 1978
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

MAXIMUM THRUST CLIMB
(FLAPS UP)

TIME TO CLIMB AND DISTANCE TRAVELED

DRAG INDEX 0 TO 200



FA3-2 (Sheet 2).

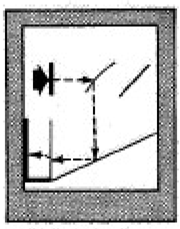
MODEL: F-5E/F
DATE: 1 MARCH 1976
DATA BASIS: **FLIGHT TEST**

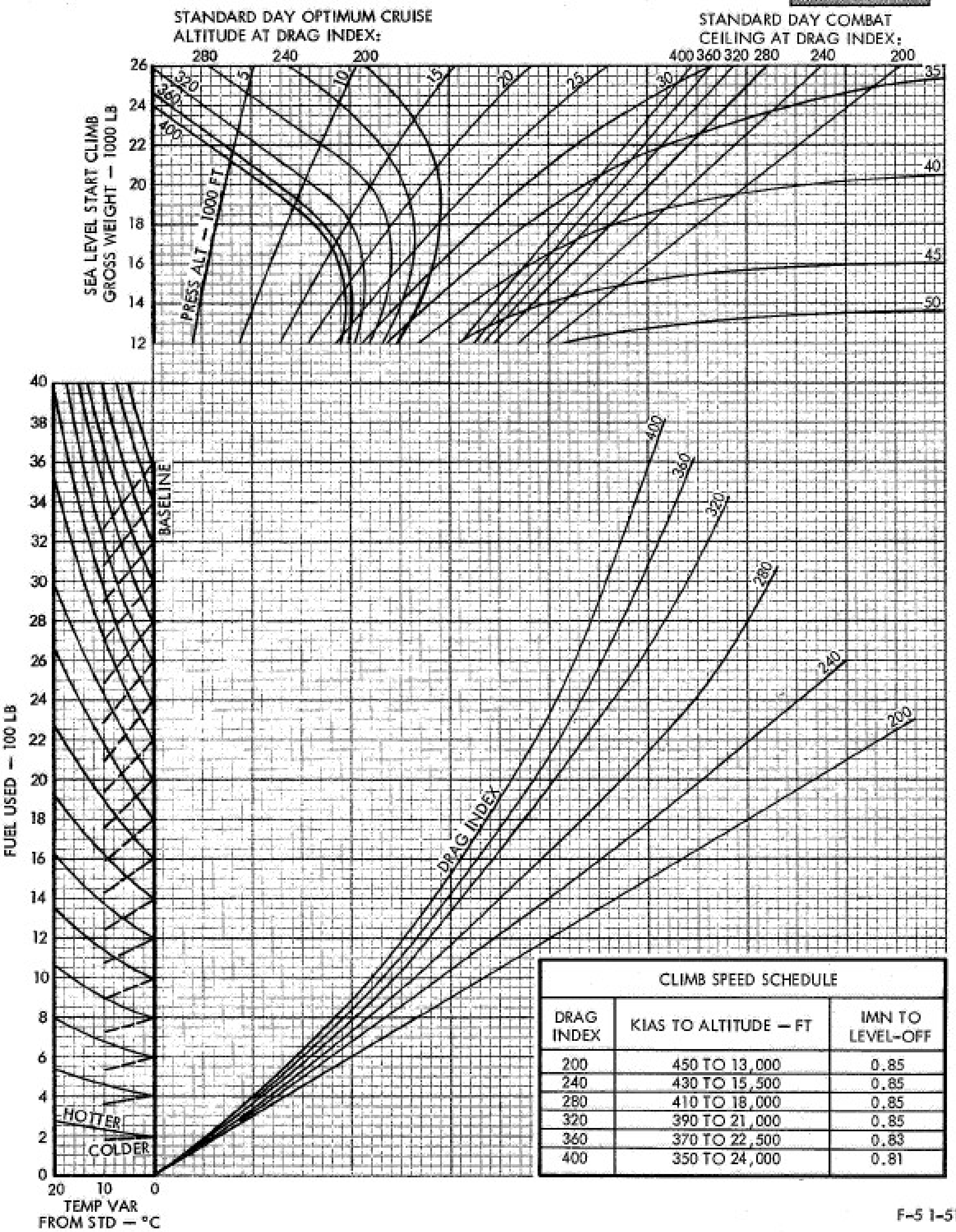
ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

MAXIMUM THRUST CLIMB (FLAPS UP)

FUEL USED

DRAG INDEX 200 TO 400





CLIMB SPEED SCHEDULE		
DRAG INDEX	KIAS TO ALTITUDE — FT	IMN TO LEVEL-OFF
200	450 TO 13,000	0.85
240	430 TO 15,500	0.85
280	410 TO 18,000	0.85
320	390 TO 21,000	0.85
360	370 TO 22,500	0.83
400	350 TO 24,000	0.81

F-5 1-512(20)

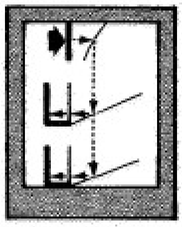
FA3-3 (Sheet 1).

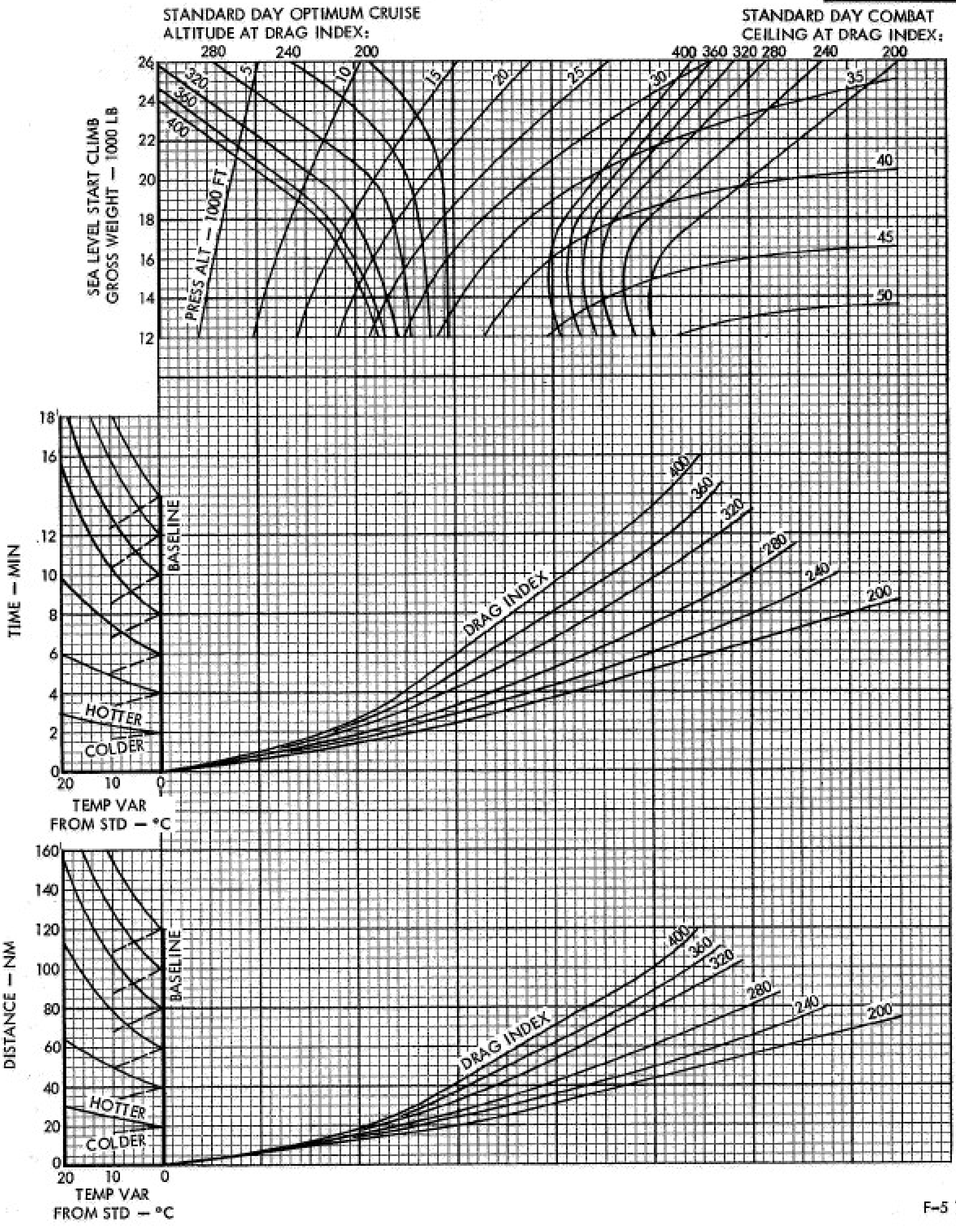
MODEL: F-5E/F
DATE: 1 MARCH 1976
DATA BASIS: **FLIGHT TEST**
ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

MAXIMUM THRUST CLIMB (FLAPS UP)

TIME TO CLIMB AND DISTANCE TRAVELED

DRAG INDEX 200 TO 400





F-5 1-514(20)

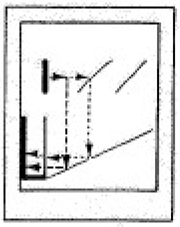
FA3-3 (Sheet 2).

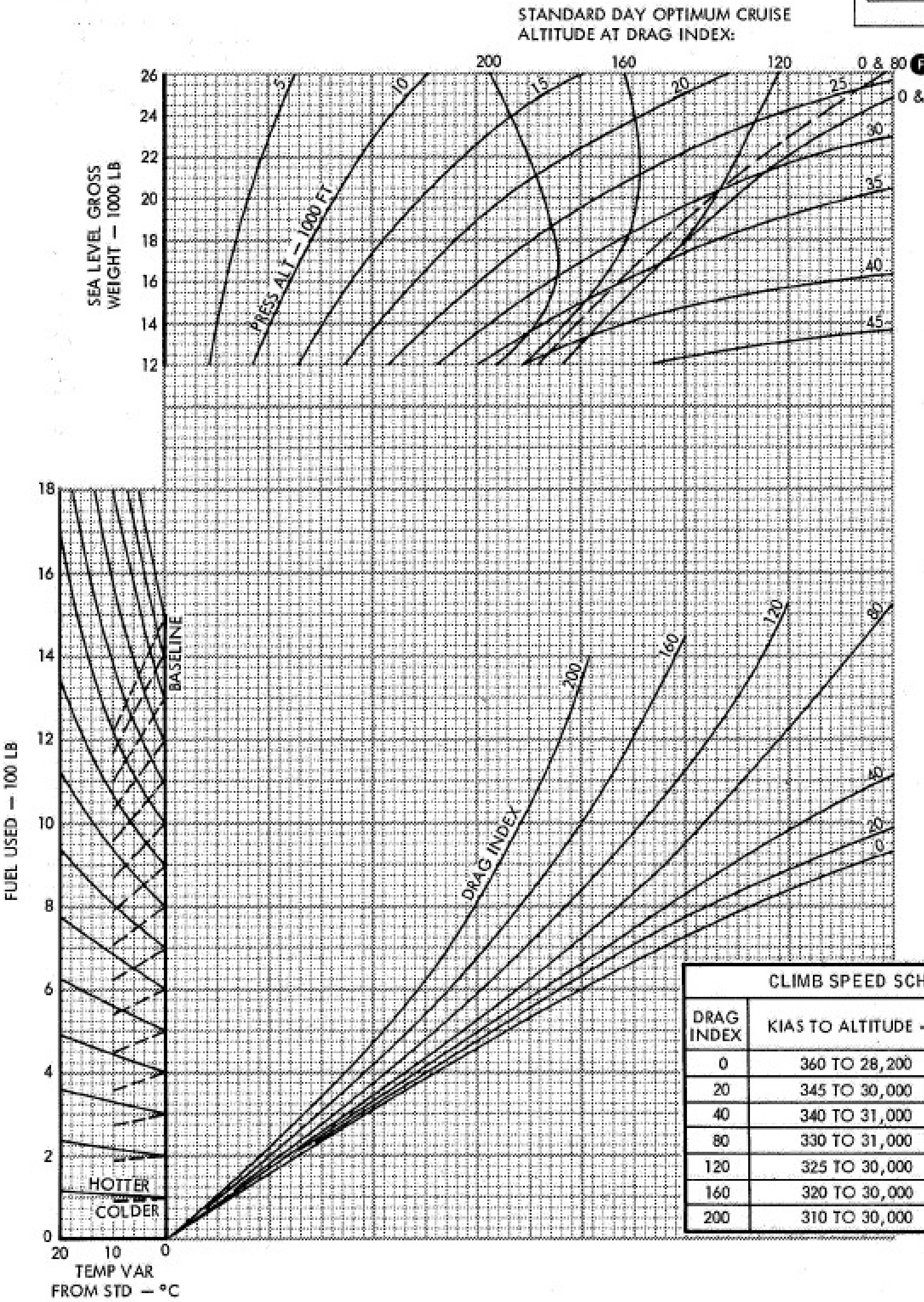
MODEL: F-5E/F
DATE: 1 MARCH 1978
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

MILITARY THRUST CLIMB (FLAPS UP)

FUEL USED
DRAG INDEX 0 TO 200





CLIMB SPEED SCHEDULE		
DRAG INDEX	KIAS TO ALTITUDE — FT	IMN TO LEVEL-OFF
0	360 TO 28,200	0.90
20	345 TO 30,000	0.90
40	340 TO 31,000	0.90
80	330 TO 31,000	0.88
120	325 TO 30,000	0.85
160	320 TO 30,000	0.83
200	310 TO 30,000	0.82

F-5 1-522(20)

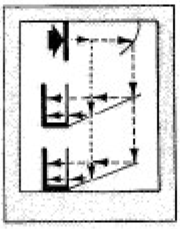
FA3-4 (Sheet 1).

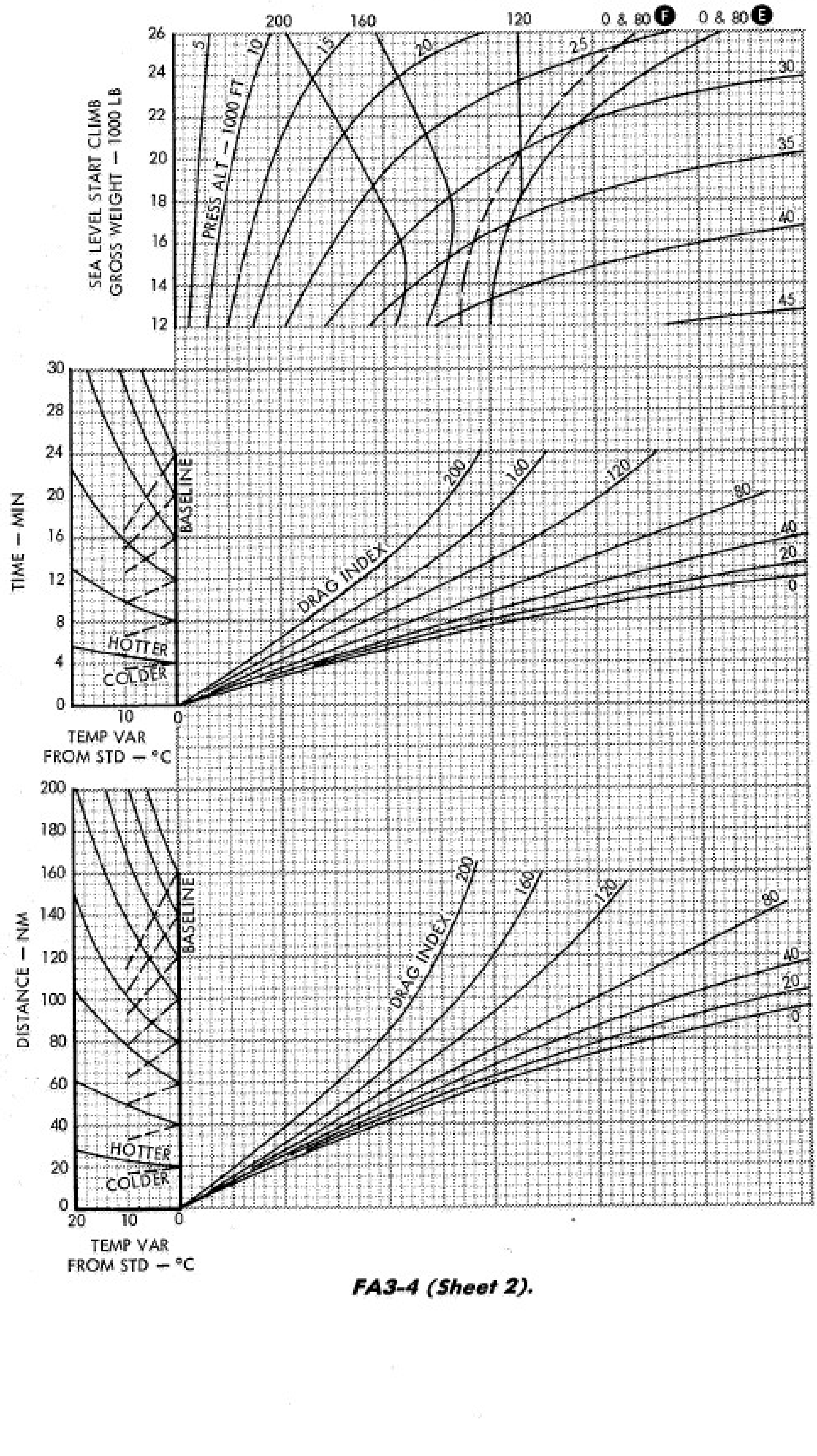
MODEL: F-5E/F
DATE: 1 MARCH 1978
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

MILITARY THRUST CLIMB (FLAPS UP)

TIME TO CLIMB AND DISTANCE TRAVELED
DRAG INDEX 0 TO 200





F-5 1-523(20)

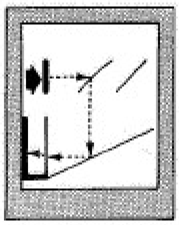
FA3-4 (Sheet 2).

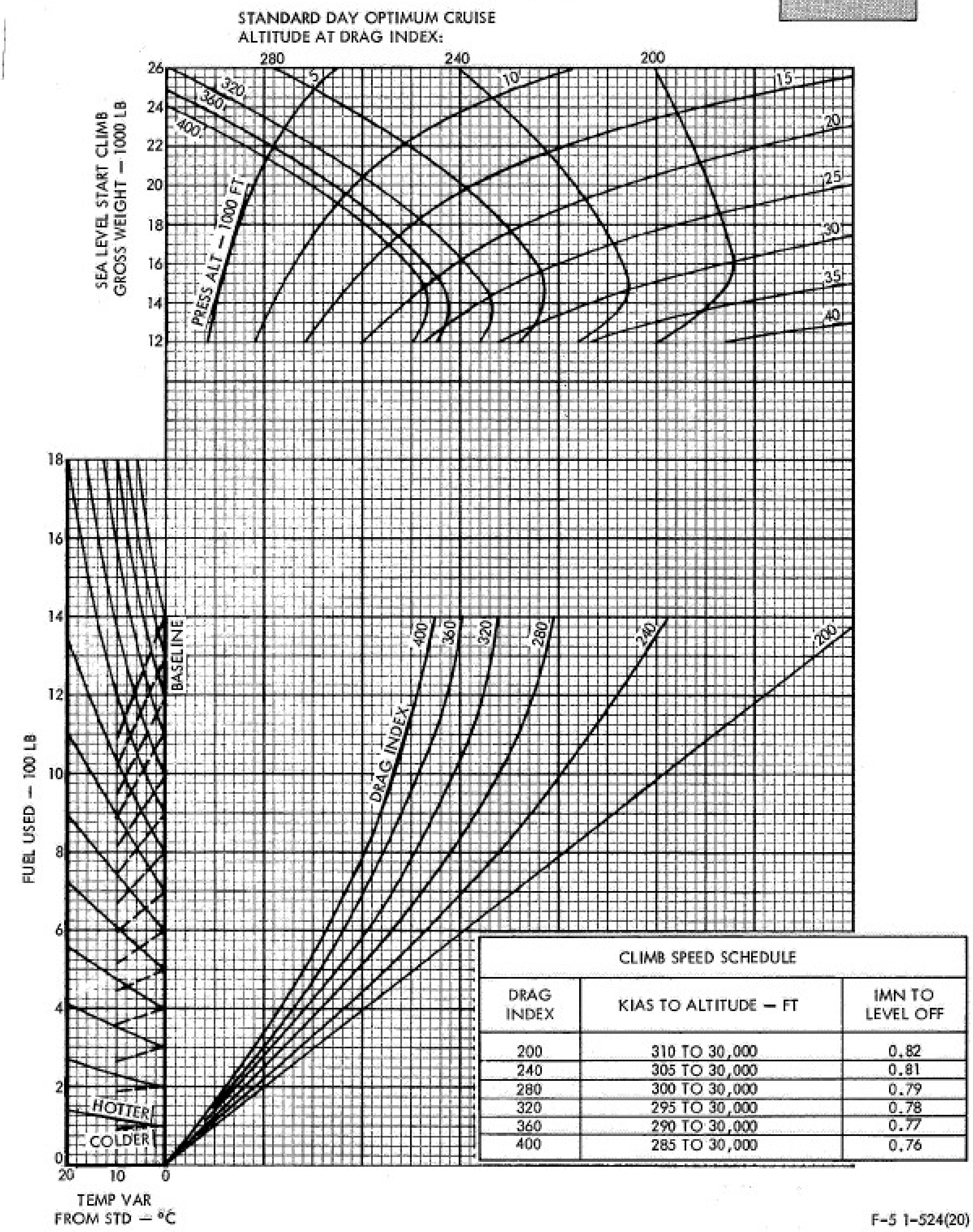
MODEL: F-5E/F
DATE: 1 MARCH 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

MILITARY THRUST CLIMB (FLAPS UP)

FUEL USED
DRAG INDEX 200 TO 400





CLIMB SPEED SCHEDULE		
DRAG INDEX	KIAS TO ALTITUDE — FT	IMN TO LEVEL OFF
200	310 TO 30,000	0.82
240	305 TO 30,000	0.81
280	300 TO 30,000	0.79
320	295 TO 30,000	0.78
360	290 TO 30,000	0.77
400	285 TO 30,000	0.76

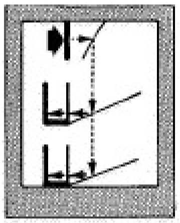
F-5 1-524(20)

FA3-5 (Sheet 1).

MODEL: F-5E/F
DATE: 1 AUGUST 1976
DATA BASIS: **FLIGHT TEST**

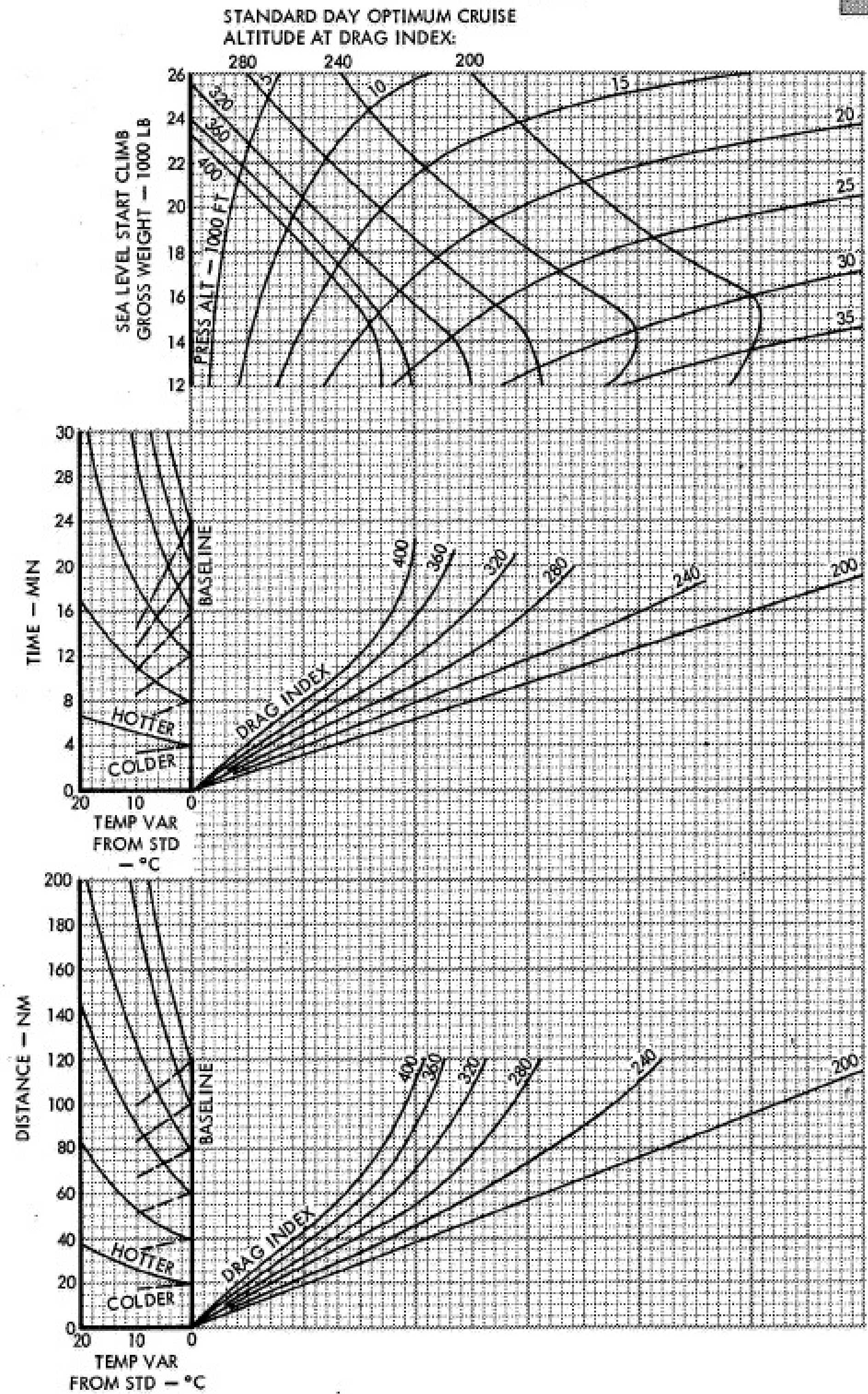
ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

MILITARY THRUST CLIMB (FLAPS UP)



TIME TO CLIMB AND DISTANCE TRAVELED

DRAG INDEX 200 TO 400



F-5 1-525(20)

FA3-5 (Sheet 2).

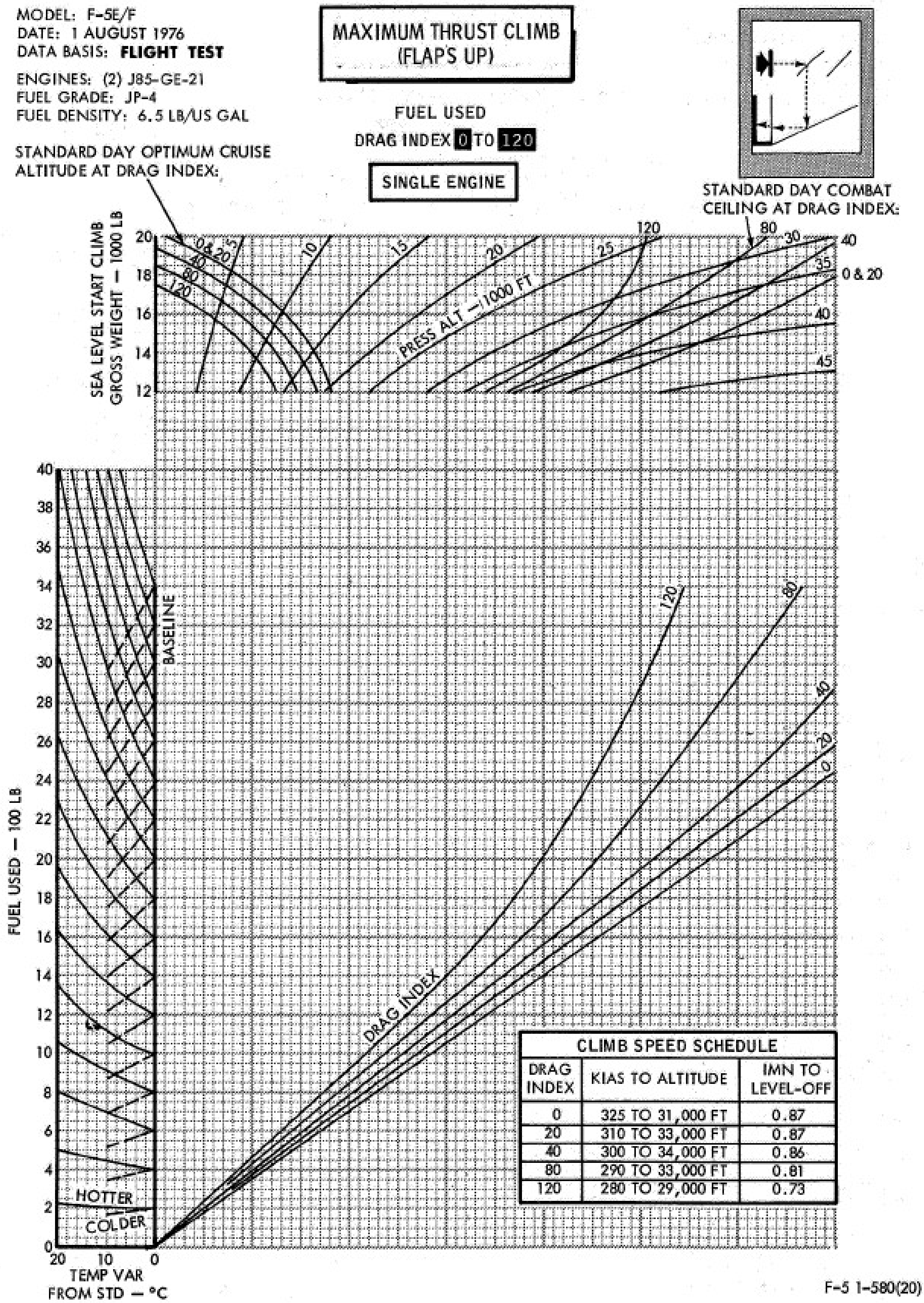
MODEL: F-5E/F
DATE: 1 AUGUST 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

MAXIMUM THRUST CLIMB (FLAPS UP)

FUEL USED
DRAG INDEX 0 TO 120

SINGLE ENGINE



CLIMB SPEED SCHEDULE		
DRAG INDEX	KIAS TO ALTITUDE	IMN TO LEVEL-OFF
0	325 TO 31,000 FT	0.87
20	310 TO 33,000 FT	0.87
40	300 TO 34,000 FT	0.86
80	290 TO 33,000 FT	0.81
120	280 TO 29,000 FT	0.73

F-5 1-580(20)

FA3-6 (Sheet 1).

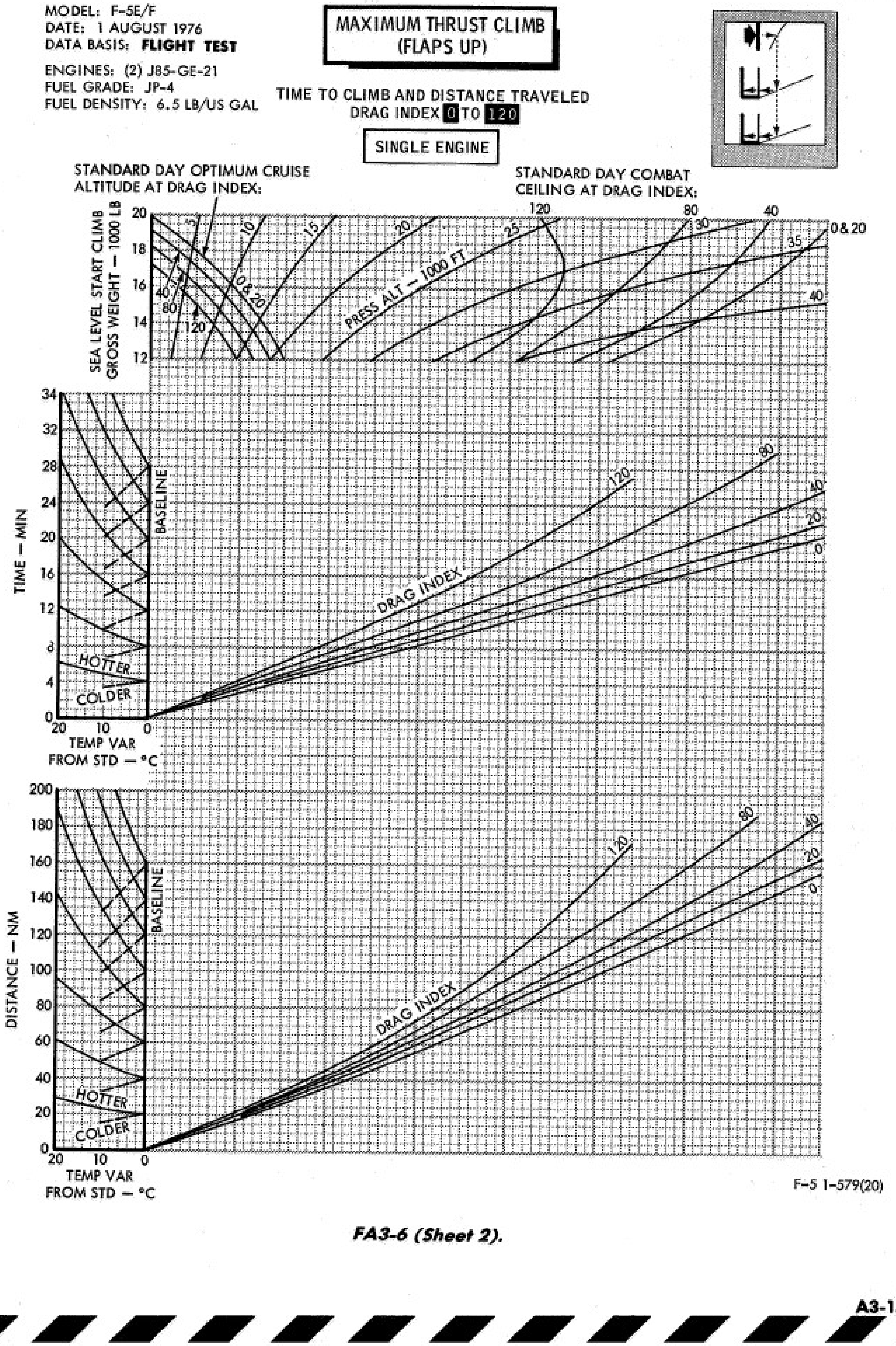
MODEL: F-5E/F
DATE: 1 AUGUST 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

MAXIMUM THRUST CLIMB (FLAPS UP)

TIME TO CLIMB AND DISTANCE TRAVELED
DRAG INDEX 0 TO 120

SINGLE ENGINE



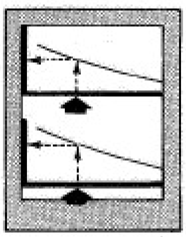
FA3-6 (Sheet 2).

MODEL: F-5E/F
DATE: 1 DECEMBER 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

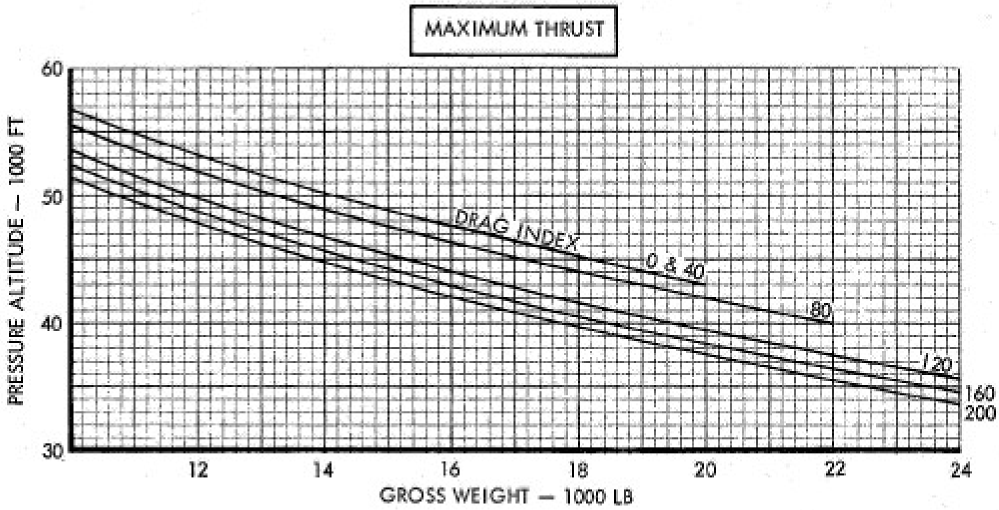
COMBAT CEILING

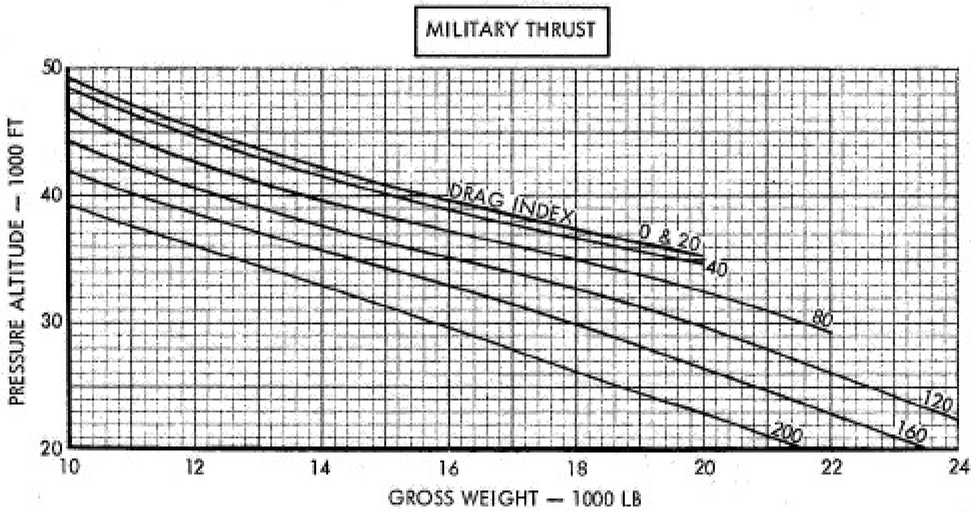
STANDARD DAY
FLAPS UP
DRAG INDEX 0 TO 200



Note

TO INCREASE CEILING BY 500 FT, USE CRUISE FLAPS AND REDUCE CLIMB SPEED 0.03 MACH.

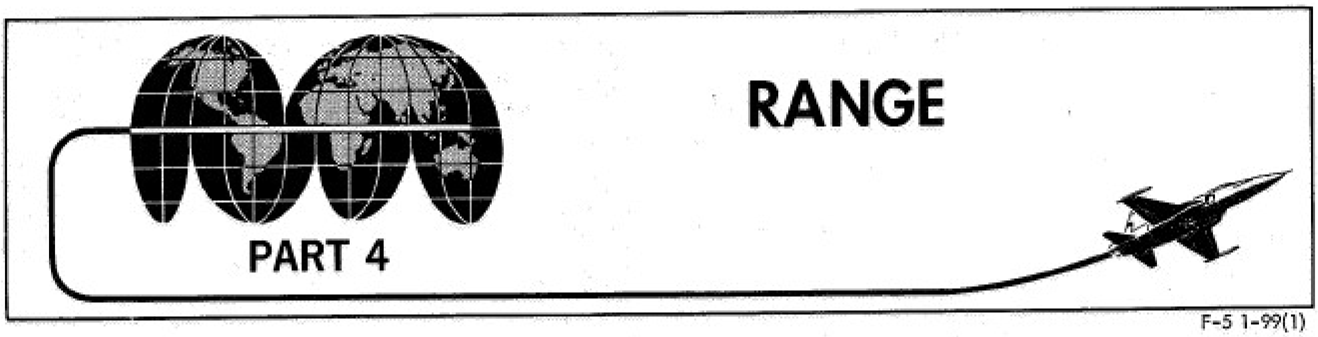




F-5 1-519(20)

FA3-7.

PART 4
RANGE



F-5 1-99(1)

TABLE OF CONTENTS

Page numbers underlined denote charts.

RANGE CHARTS (GENERAL)

The range charts determine the optimum conditions under which the aircraft can be operated during cruise in order to obtain the maximum distance per pound of fuel, or conversely, to determine the feasibility of operation under a given set of conditions.

OPTIMUM CRUISE ALTITUDE FOR SHORT RANGE MISSIONS

For a short range mission, the cruise altitude may optimize at a lower altitude than is required for a long range mission. The Optimum Cruise Altitude for Short Range missions chart (FA4-1) presents the cruise altitude for short range missions as a function of climb-plus-cruise-plus-descent distance. The cruise altitude optimizes slightly higher than shown if a maximum range descent on course is used, and slightly lower if the descent is made over the destination. If the intersection of the drag index and mission range distance plot falls outside the dashed "Use Optimum Cruise Altitude" line, obtain optimum cruise altitude from FA4-2 or FA4-3, as appropriate.

USE

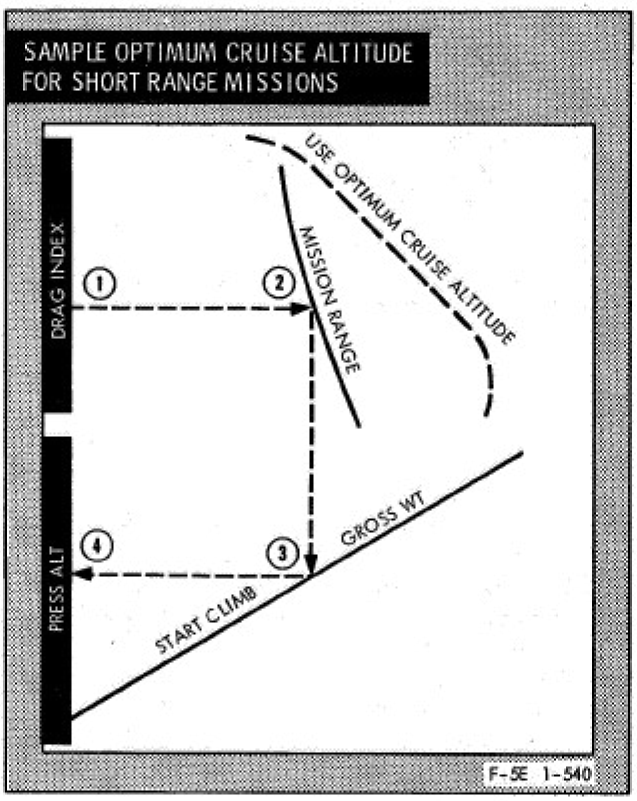
Enter chart with drag index and proceed right to the desired mission range distance, then down to the start climb gross weight. From this point, proceed left to read pressure altitude for cruise.

SAMPLE PROBLEM

Given:
A. Configuration drag index: 120.
B. Mission range distance: 100 nm.
C. Start climb gross weight: 19,980 lb.

Calculate:
A. Optimum cruise altitude.
B. Use Optimum Cruise Altitude for Short Range Missions chart FA4-1.

①	Drag Index	120
②	Mission Range	100 nm
③	Start Climb Gross Wt	19,980 lb
④	Press Alt	17,500 ft



OPTIMUM CRUISE ALTITUDE CHARTS

The Optimum Cruise Altitude charts for standard and nonstandard day (+ 10°C and +20°C) for two-engine operation are presented in FA4-2 and FA4-3, respectively. Similar charts for single-engine operation are presented in FA4-4 and FA4-5. These charts provide the optimum cruise altitudes for maximum range cruise as a function of the gross weight at altitude and the drag index.

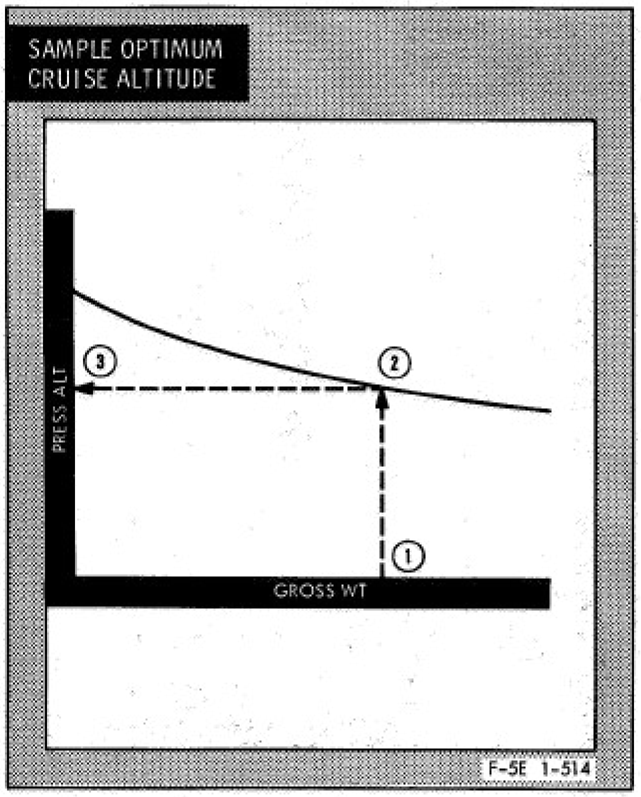
USE

Enter the appropriate chart with gross weight and proceed up to the drag index, then left and read the optimum cruise pressure altitude.

SAMPLE PROBLEM

Given:
A. Gross weight at altitude: 18,755 lb.
B. Drag index: 120
C. Two-engine operation.

Calculate:
A. Optimum cruise altitude.



B. Use Optimum Cruise Altitude chart FA4-2.

①	Gross Wt	18,755 lb
②	Drag Index	120
③	Press Alt	30,250 ft

CONSTANT ALTITUDE CRUISE CHARTS

The Constant Altitude Cruise charts for two-engine operation (FA4-6, sheets 1 and 2) and for single-engine operation (FA4-7, sheets 1 and 2) provide cruise data based on long range cruise mach number. Long range cruise mach number is that speed faster than maximum range cruise mach number which provides 99% of the maximum cruise range. Flaps are up for cruise.

Sheet 1 provides optimum indicated cruise mach number as a function of average gross weight, pressure altitude, and drag index. The remainder of the chart is an aid in obtaining values of true airspeed or groundspeed and time as a function of the indicated mach number, temperature, and ground distance. Sheet 2 provides specific range (nautical miles per pound of fuel) as a function of average gross weight, pressure altitude, and drag index. Fuel flow and fuel required may be obtained from the remainder of the chart as a function of specific range, true airspeed, and time. The values of true airspeed and time are obtained from sheet 1.

The Constant Altitude Cruise charts should be used for mission planning when optimum range capability is desired, and the Nautical Miles-per-Pound of Fuel charts (FA4-8 and FA4-9) should be used when other than optimum cruise mach numbers are required.

USE

Enter sheet 1 with average gross weight, proceed right to cruise pressure altitude, down to drag index, then left and read optimum indicated mach number. At this value of mach number, proceed right to the temperature baseline, and parallel the nearest guideline to the temperature applicable to the cruise altitude. Continue right from this point to the zero wind line, and at this position read the true airspeed on the scale at the bottom of the chart. Correct the airspeed to groundspeed by moving left (for headwind) or right (for tailwind) by the amount of the wind, and read the ground speed on the same scale at the bottom of the chart. Move up at the correct value of groundspeed to the ground distance curve applicable to cruise (interpolate, if necessary), then left and read time to cruise.

Enter sheet 2 with average gross weight, move right to cruise altitude and down to drag index. Move left and read nautical miles-per-pound of fuel (specific range). At this value of specific range, proceed right to the true airspeed curve (interpolate, if necessary), then proceed up, noting the values of fuel flow, and continue up to the time required for cruise obtained from sheet 1. From this point, move left and read fuel required.

ALTERNATE USE

A. If fuel available for cruise is known, rather than cruise distance, time will have to be obtained from sheet 2 and used in sheet 1 to obtain the distance.

Thus:

1. Enter sheet 1 as previously described and proceed to obtain true airspeed (zero wind).
2. Enter sheet 2 as previously described and "chase-thru" to obtain fuel flow point of intersection, which is the extension of the vertical upward line from the true airspeed point of intersection. Project a

horizontal line from the fuel required scale (fuel available), and project a vertical line from the fuel flow point of intersection. Where the two projected lines intersect, read time in minutes.

3. Reenter sheet 1 at the true airspeed point of intersection previously plotted, and move left or right to the appropriate headwind or tailwind value. Note groundspeed, and project a vertical line upward thru the ground distance curves. Also project a line horizontally right from the time value found in sheet 2, and at the intersection of these two lines read ground distance.

B. Distance can also be computed, rather than read from sheet 1, if the specific range (nautical miles-per-pound of fuel) obtained in sheet 2 is multiplied by the fuel available for cruise.

NOTE

Computation will result in air distance. Obtain ground distance by correcting for headwind or tailwind.

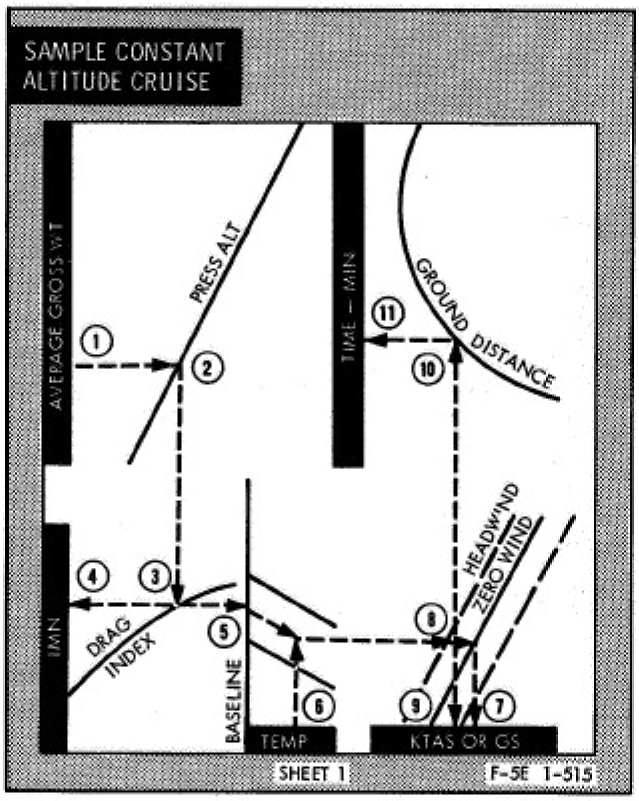
C. When the average gross weight is not known initially, it may be necessary to run thru the charts once to obtain a value of cruise fuel based on the start cruise weight and then reread the charts using the start cruise weight reduced by half of the fuel found for cruise.

SAMPLE PROBLEM

Given:
A. Gross weight (average): 17,755 lb.
B. Cruise pressure altitude: 32,000 ft.
C. Drag index: 120
D. Temperature (at altitude): –48.4°C.
E. Headwind: 25 kt.
F. Ground distance: 300 nm.

Calculate:
A. Indicated mach number, true airspeed, ground speed, time, specific range, fuel flow, and fuel required.
B. Use Constant Altitude Cruise chart FA4-6, sheet 1.

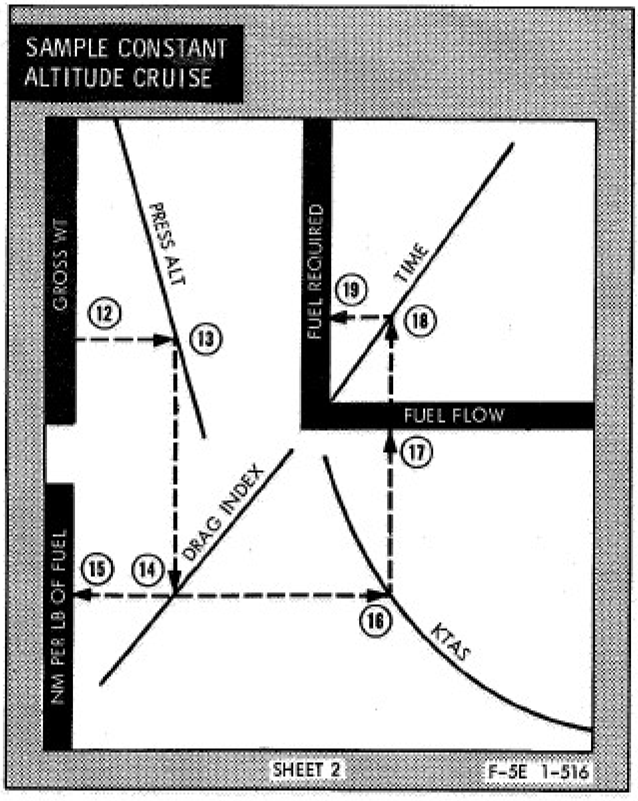
①	Gross Wt (avg)	17,755 lb
②	Press Alt	32,000 ft



③	Drag Index	120
④	IMN	0.86
⑤	Baseline	———
⑥	Temp (std day)	–48.4°C
⑦	True Airspeed (zero wind)	510 KTAS
⑧	Headwind	25 kt
⑨	Groundspeed	485 kt
⑩	Ground Distance	300 nm
⑪	Time	37 min

C. Use Constant Altitude Cruise Chart FA4-6, sheet 2.

⑫	Gross Wt (avg)	17,755 lb
⑬	Press Alt	32,000 ft
⑭	Drag Index	120
⑮	Nm-per-Lb of Fuel (Specific Range)	0.15
⑯	True Airspeed	510 KTAS
⑰	Fuel Flow	3400 pph
⑱	Time	37 min
⑲	Fuel Required	2100 lb



NAUTICAL MILES-PER-POUND OF FUEL CHARTS (GENERAL)

The Nautical Miles-per-Pound of Fuel charts provide cruise data throughout the speed range from approximately maximum endurance to 0.95 mach. Charts are provided for two-engine and single-engine operation. These charts are used when the cruise mach number is other than optimum long range speed.

The Nautical Miles-per-Pound of Fuel charts for two-engine operation consist of three charts (FA4-8 sheets 1 thru 3). Sheet 1 is used to obtain a reference number which, when used in sheet 2, provides specific range for the particular conditions of the flight. In sheet 3, cruise mach number and temperature define true airspeed which, when combined with specific range, provides fuel flow per engine. The single-engine charts (FA4-9 sheets 1 thru 3) are identical in format and are used in the same manner as the two-engine charts.

USE

Enter sheet 1 with the average cruise gross weight, right to the pressure altitude, and then down thru the indicated mach number scale directly to the baseline. From this point of intersection with the baseline, contour the guideline either to the left or to the right to the desired cruise indicated mach number projected down from the indicated mach number scale. At this point of intersection, proceed right with a projected line thru the reference number grid plot. Enter the upper right portion of the chart with indicated mach number and move right to the appropriate drag index, then proceed down to intersect the horizontal projection which was plotted previously thru the reference number grid. At this intersection, read the value of reference number for use with sheet 2.

Enter sheet 2 with the indicated mach number and proceed right to the reference number curve for the reference number value obtained in sheet 1; (interpolate, if necessary). From this intersection move up to the pressure altitude and then right and read nautical miles per pound. Enter sheet 3 with the nautical miles per pound and project a line to the right. Next, enter with indicated mach number and proceed right to the temperature curve applicable to the cruise pressure altitude. From this point, project up to the horizontal line previously projected, and read fuel flow per engine. True airspeed, if desired, can be read at the intersection of the vertical with the KTAS scale. A reference table is provided on the chart for temperature vs pressure altitude based on a standard day.

SAMPLE PROBLEM

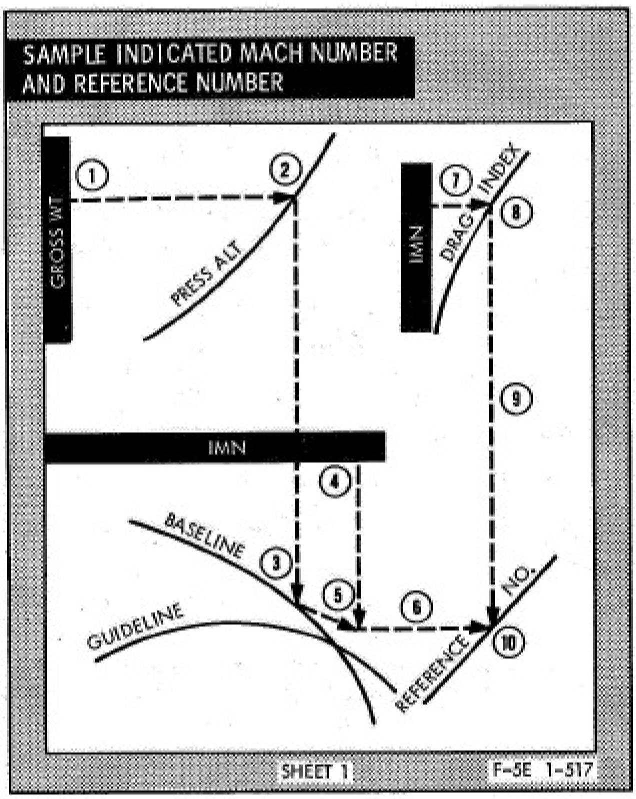
Given:

A. Gross weight (average): 17,775 lb.
B. Desired cruise mach number: 0.9 IMN.
C. Drag index: 120.
D. Cruise pressure altitude: 32,000 ft.
E. Temperature (at altitude): –48.4°C.

Calculate:

A. Reference number, nautical miles per pound of fuel, fuel flow, and true airspeed.
B. Use Nautical Miles Per Pound of Fuel, Indicated Mach Number and Reference Number chart FA4-8, sheet 1.

①	Gross Wt (avg)	17,755 lb
②	Press Alt	32,000 ft
③	Baseline	——
④	IMN (desired cruise)	0.9
⑤	Intersect Guideline Contour	——
⑥	Projected Line (thru reference number grid)	——
⑦	IMN	0.9
⑧	Drag Index	120



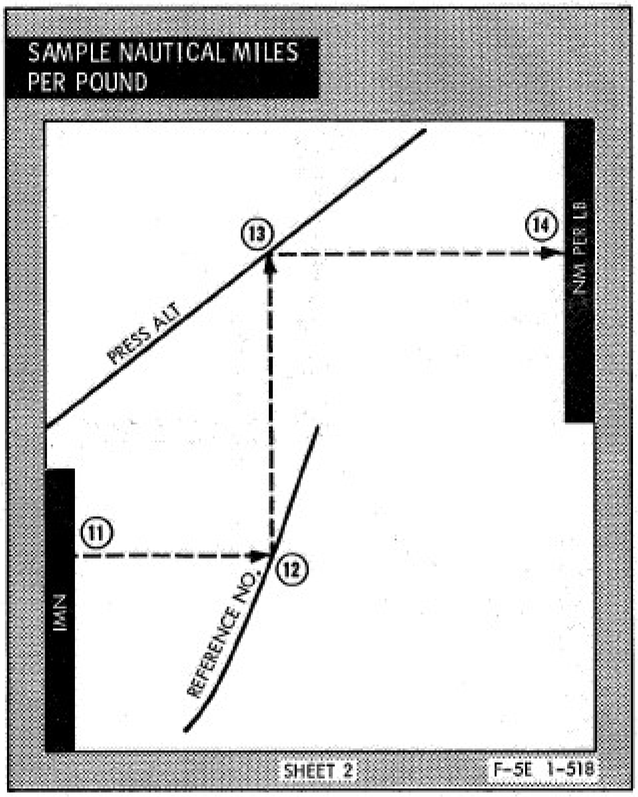
- ⑨ Projected Line (thru reference number grid) ——
- ⑩ Reference No. 9.2

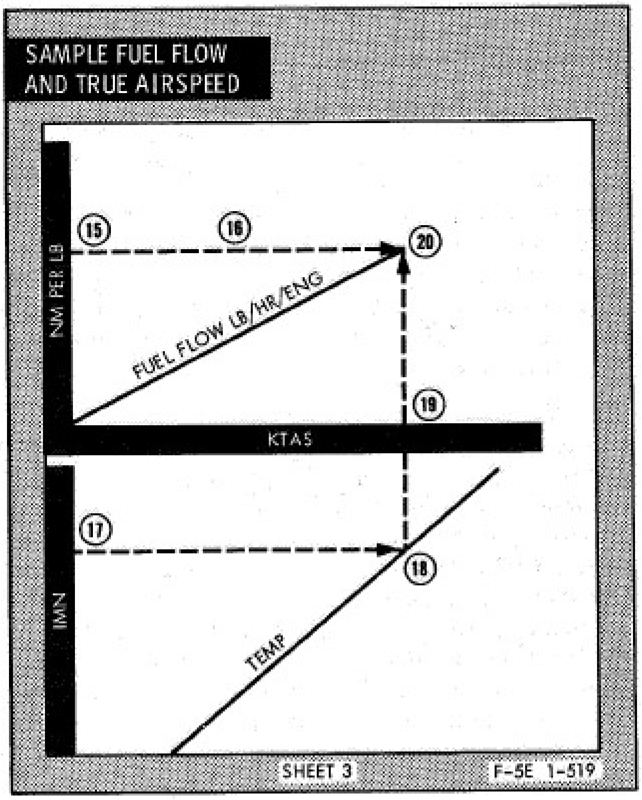
C. Use Nautical Miles Per Pound of Fuel, Nautical Miles Per Pound chart FA4-8, sheet 2.

- ⑪ IMN 0.9
- ⑫ Reference No. 9.2
- ⑬ Press Alt 32,000 ft
- ⑭ Nm-per-Lb (of fuel) 0.15

D. Use Nautical Miles Per Pound of Fuel, Fuel Flow and True Airspeed chart, FA 4-8, sheet 3.

- ⑮ Nm-per-Lb (of fuel) 0.15
- ⑯ Projected Line (thru fuel flow grid) ——
- ⑰ IMN 0.9
- ⑱ Temp (std day) –48.4°C
- ⑲ True Airspeed 525 KTAS
- ⑳ Fuel Flow (per engine) 1780 pph





DIVERSION RANGE CHARTS

Diversion range charts for two-engine and single-engine operation are presented as flight profile type charts in figure FA4-10, sheets 1 thru 6. The charts for single-engine operation provide for cruise without and with partial AB power. Partial AB profile provides a higher cruise altitude and should be used if required for terrain clearance. Each diversion range chart provides the maximum range obtainable for two optional return profiles with from 600 to 1400 pounds of available fuel remaining. The range pertains to an aircraft with AIM-9 missiles and five pylons and is based on having 300 pounds of fuel remaining for approach and landing after descent is completed. A climb speed schedule and recommended long range cruise indicated mach number are tabulated on each chart. Climb-cruise and descent-cruise guidelines on the charts show the flight path, which will provide the maximum range for the return procedure used. Initial points to the right of the climb guidelines require climb to and cruise at optimum altitude.

The two types of diversion range flight profile procedures shown on each chart are:

TWO ENGINE

Profile 1.

a. Climb on course at MIL thrust to optimum altitude. If at optimum altitude, no climb is required.
b. Cruise at optimum altitude to base.
c. Descent after arrival over base: 300 KIAS, 80% RPM, maneuvering flaps, speed brake OUT.

Profile 2.

a. Climb on course at MIL thrust to optimum altitude. If at optimum altitude, no climb is required.
b. Cruise at optimum altitude.
c. Maximum range, descent on course: 270 KIAS, IDLE RPM, flaps up, speed brake IN.

SINGLE ENGINE (W/O AFTERBURNER)

Profile 1.

a. Descend on course at MIL power at 270 (Ⓕ 275) KIAS to optimum cruise altitude. If at optimum altitude, no descent required.
b. Cruise at optimum altitude to base.
c. Maximum range descent after arrival over base.

Profile 2.

a. Climb at MIL power to optimum cruise altitude or descend on course at MIL power at 270 (Ⓕ 275) KIAS. If at optimum altitude, no climb or descent required.
b. Cruise at optimum altitude (if required).
c. Maximum range descent on course to base.

NOTE

Maximum range descent at: 270 (Ⓕ 275) KIAS, IDLE rpm, flaps up, and speed brake IN.

SINGLE ENGINE (PARTIAL AFTERBURNER)

Profile 1.

a. Climb at MAX thrust, or descend on course at MIL power to optimum cruise altitude. If at optimum altitude, no climb or descent required.
b. Cruise at optimum altitude.
c. Maximum range descent after arrival over base.

Profile 2.

a. Climb at MAX thrust or descend on course at MIL power to optimum cruise altitude. If at optimum altitude, no descent required.
b. Cruise at optimum altitude (if required).
c. Maximum range descent on course to base.

NOTE

- Cruise at optimum altitude with modulated afterburner to maintain altitude.
- Maximum range descent at: 270 (Ⓕ 275) KIAS, IDLE rpm, flaps up, and speed brake IN.

USE

If a penetration descent after arrival over base is desired, use profile 1. If there is insufficient fuel for profile 1, then profile 2 may be used to obtain extra range. The chart may be entered at the initial altitude with either the fuel on board (to determine the range available) or with the distance to be flown (to determine the fuel required).

To determine range, enter the appropriate profile chart with initial altitude, move horizontally right to the pounds of fuel remaining curve, and then vertically down to read the air distance. To determine the optimum cruise altitude for two-engine operation, start at this intersection and move up parallel to the nearest climb path guideline to intersect the nearest optimum cruise altitude. To determine optimum cruise altitude for single-engine operation, start at the intersection and move up or down parallel to the nearest guideline to intersect the nearest optimum cruise altitude. Single-engine operation may require either up or down movement, depending upon initial altitude.

NOTE

- Maximum range can be obtained only by climb or descent to optimum altitude.
- If the intersection plot of the initial altitude and fuel remaining curve coincides on the optimum cruise altitude, remain at that altitude for cruise.

Cruise indicated mach number in each chart is given in the column next to the altitude scale. For profile 2, the range at which to begin the maximum range descent to base is determined by reading the air distance at the intersection of the cruise altitude line with the descent line.

To determine the fuel required for a given distance to return to base, enter the chart with initial altitude, and move horizontally right to a point of intersection with the distance to base. At this point, read the fuel required, then proceed parallel to the nearest climb or descent path guideline to determine the optimum cruise altitude.

SAMPLE PROBLEM

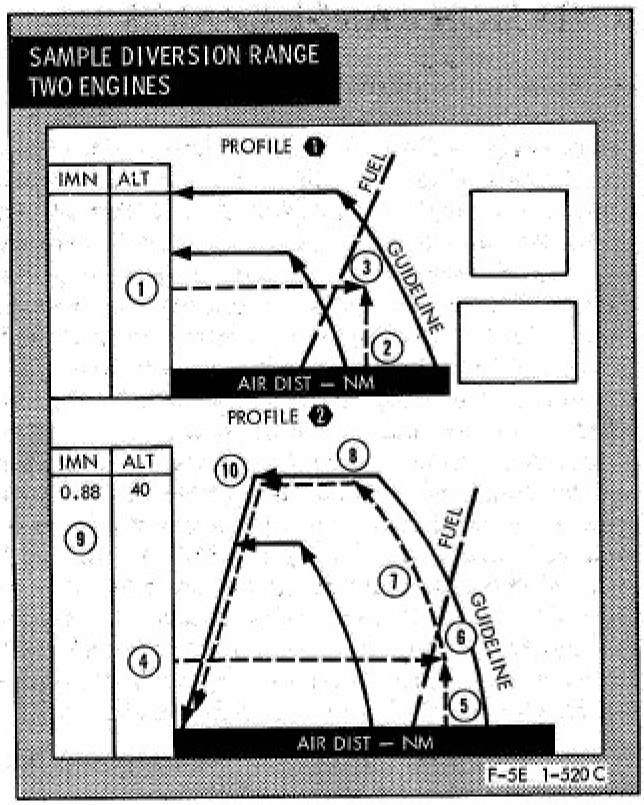
Given:

A. Configuration with wingtip missiles, five empty pylons, and two engines operating.
B. Initial altitude: 10,000 ft.
C. Distance to base: 150 nm
D. Fuel remaining: 1150 lb.

Calculate:

A. Diversion range flight profile.
B. Use Diversion Range chart FA4-10, sheet 1, enter Profile 1.

①	Initial Alt	10,000 ft
②	Dist	150 nm
③	Fuel Required	1330 lb



C. Since fuel required for 150 nm at 10,000 ft is 1330 lb, Profile 1 will not allow a safe return to base.
D. Enter Profile 2 of same chart.

④	Initial Alt	10,000 ft
⑤	Dist	150 nm
⑥	Fuel Required	1100 lb

E. Since fuel required in this profile is 50 lb less than fuel remaining, continue with profile requirements.

⑦	Contour Guideline	———
⑧	Optimum Alt	40,000 ft
⑨	Cruise Airspeed	0.88 IMN
⑩	Start Descent	46 nm

NOTE

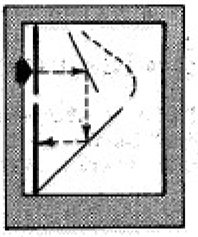
Refer to note and profile instructions on chart for climb and descent; airspeed; power; flap and speed brake position; fuel and distance credit.

MODEL: F-5E/F
DATE: 1 MARCH 1976
DATA BASIS: **ESTIMATED**

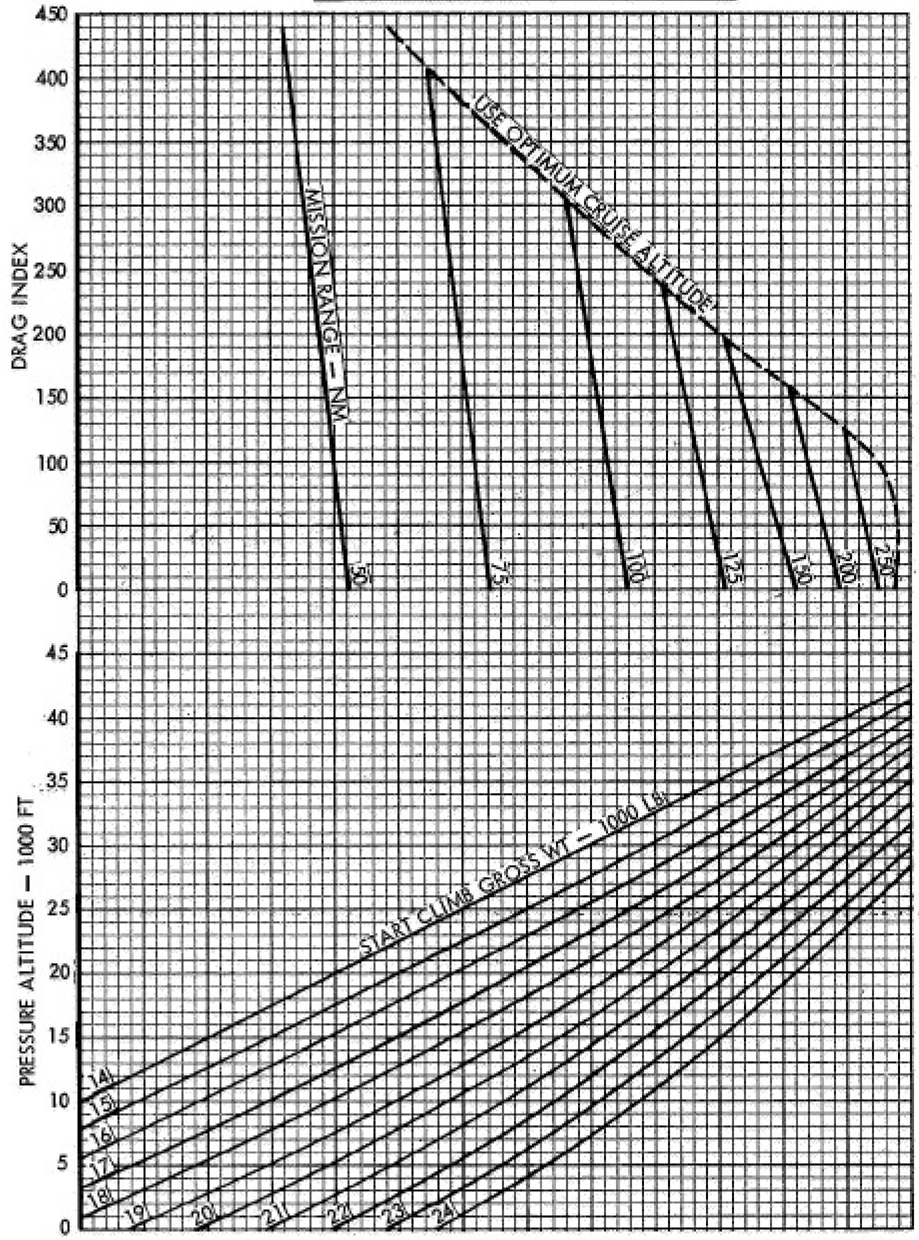
ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

OPTIMUM CRUISE ALTITUDE FOR SHORT-RANGE MISSIONS (FLAPS UP)

STANDARD DAY



CONDITIONS
- MILITARY THRUST CLIMB.
- LONG-RANGE CRUISE IMN.
- PENETRATION DESCENT ON COURSE WITH SPEED BRAKE OUT.



F-5 1-595(20)

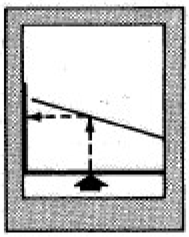
FA4-1.

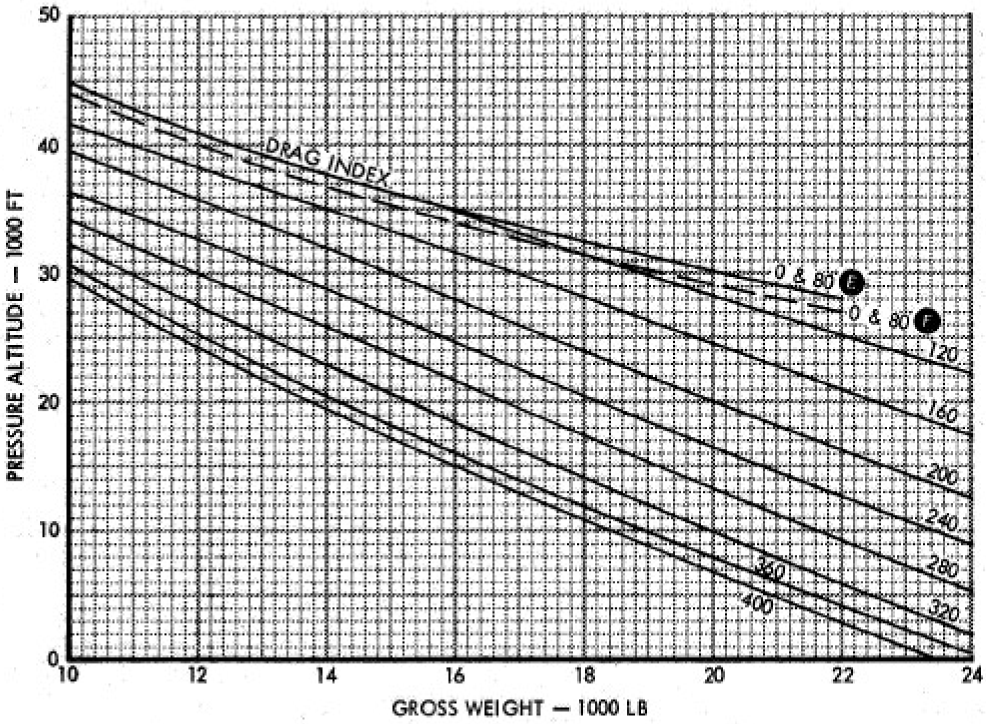
MODEL: F-5E/F
DATE: 1 MARCH 1978
DATA BASIS: **FLIGHT TEST**

ENGINES: (2)J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

OPTIMUM CRUISE ALTITUDE (FLAPS UP)

STANDARD DAY





F-5 1-574(20)

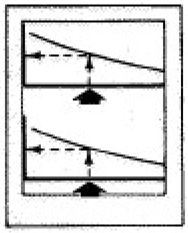
FA4-2.

MODEL: F-5E/F
DATE: 1 MARCH 1978
DATA BASIS: **FLIGHT TEST**

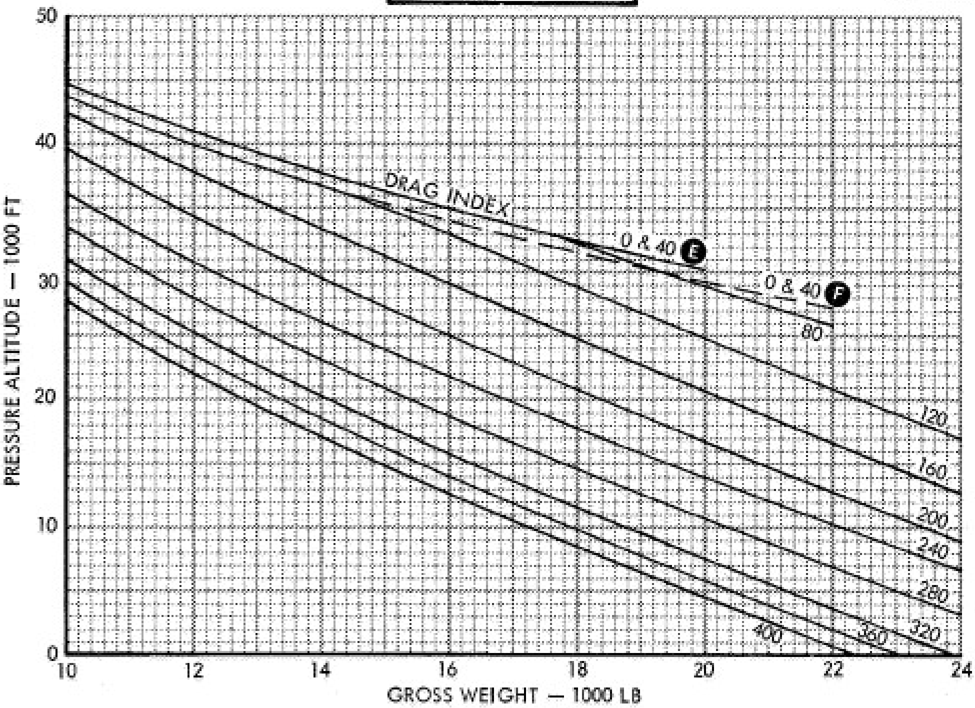
ENGINES: (2)J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

OPTIMUM CRUISE ALTITUDE (FLAPS UP)

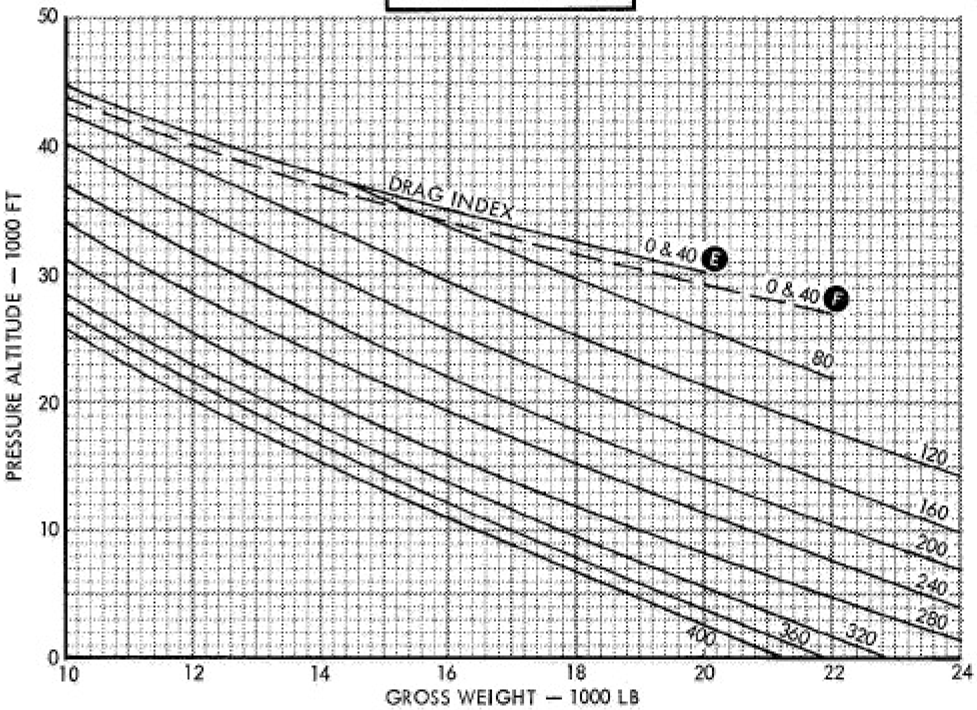
NONSTANDARD DAY



STANDARD DAY +10°C



STANDARD DAY +20°C



F-5 1-596(20)A

FA4-3.

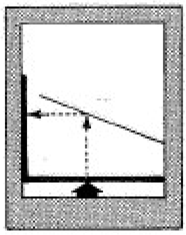
MODEL: F-5E/F
DATE: 1 MARCH 1976
DATA BASIS: **FLIGHT TEST**

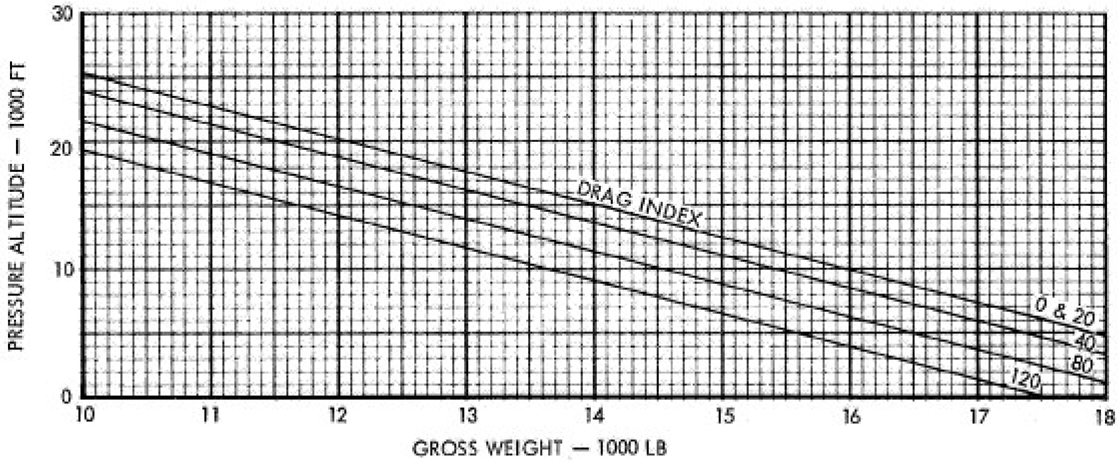
ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

OPTIMUM CRUISE ALTITUDE (FLAPS UP)

STANDARD DAY

SINGLE ENGINE





F-5 1-575(20)

FA4-4.

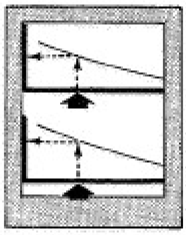
MODEL: F-5E/F
DATE: 1 MARCH 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

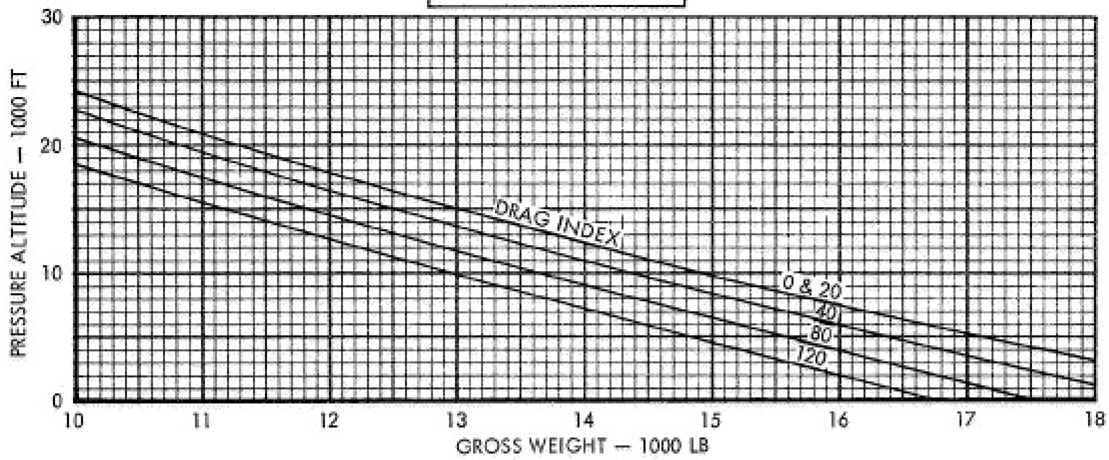
OPTIMUM CRUISE ALTITUDE (FLAPS UP)

NONSTANDARD DAY

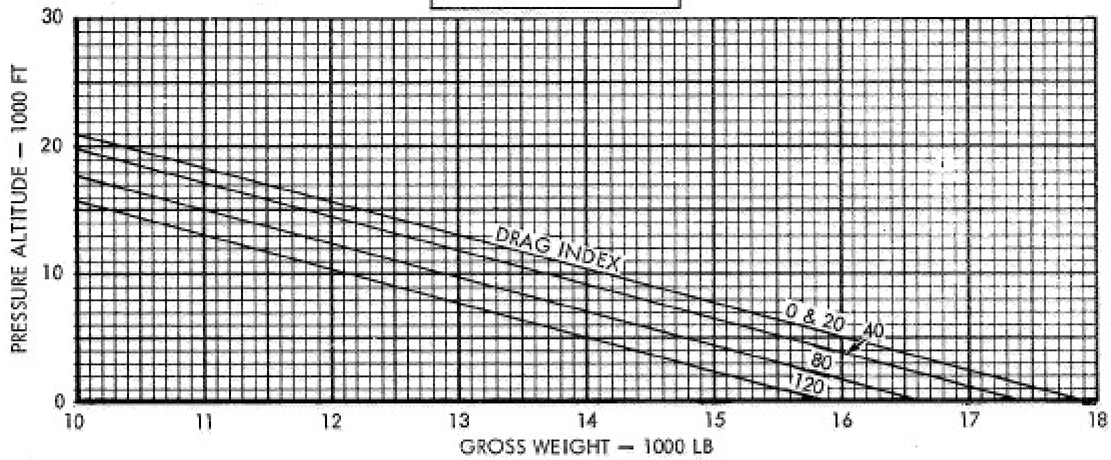
SINGLE ENGINE



STANDARD DAY +10°C



STANDARD DAY +20°C



F-5 1-597(20)

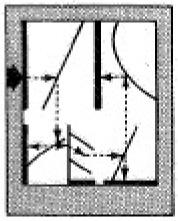
FA4-5.

MODEL: F-5E/F
DATE: 1 MARCH 1976
DATA BASIS: **FLIGHT TEST**
ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

CONSTANT ALTITUDE CRUISE (FLAPS UP)

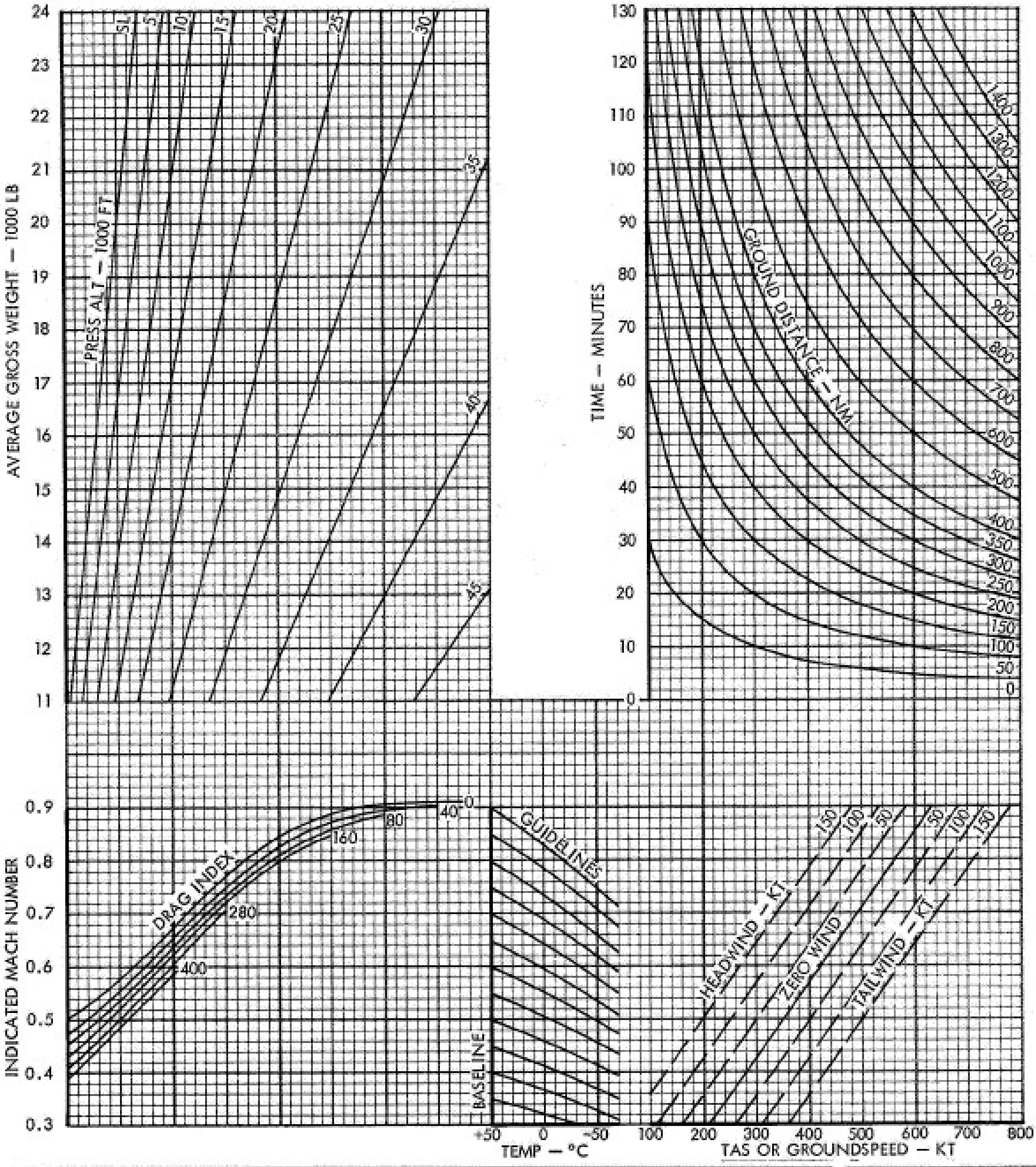
LONG RANGE SPEED
INDICATED MACH NUMBER, TRUE AIRSPEED
GROUNDSPEED, AND TIME

DRAG INDEX 0 TO 400



Note

FOR MAX RANGE, REDUCE CRUISE MACH BY 0.03.



STANDARD DAY									
ALT — 1000 FT	SL	5	10	15	20	25	30	35	36, 089 & ABOVE
TEMP — °C	15.0	5.1	-4.8	-14.7	-24.6	-34.5	-44.4	-54.3	-56.5

SPEED
——— GROUND OR AIR
— — GROUND

F-5 1-528(20)

FA4-6 (Sheet 1).

MODEL: F-5E/F
DATE: 1 MARCH 1976
DATA BASIS: **FLIGHT TEST**

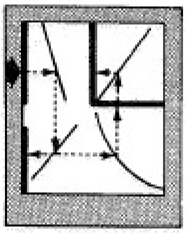
ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

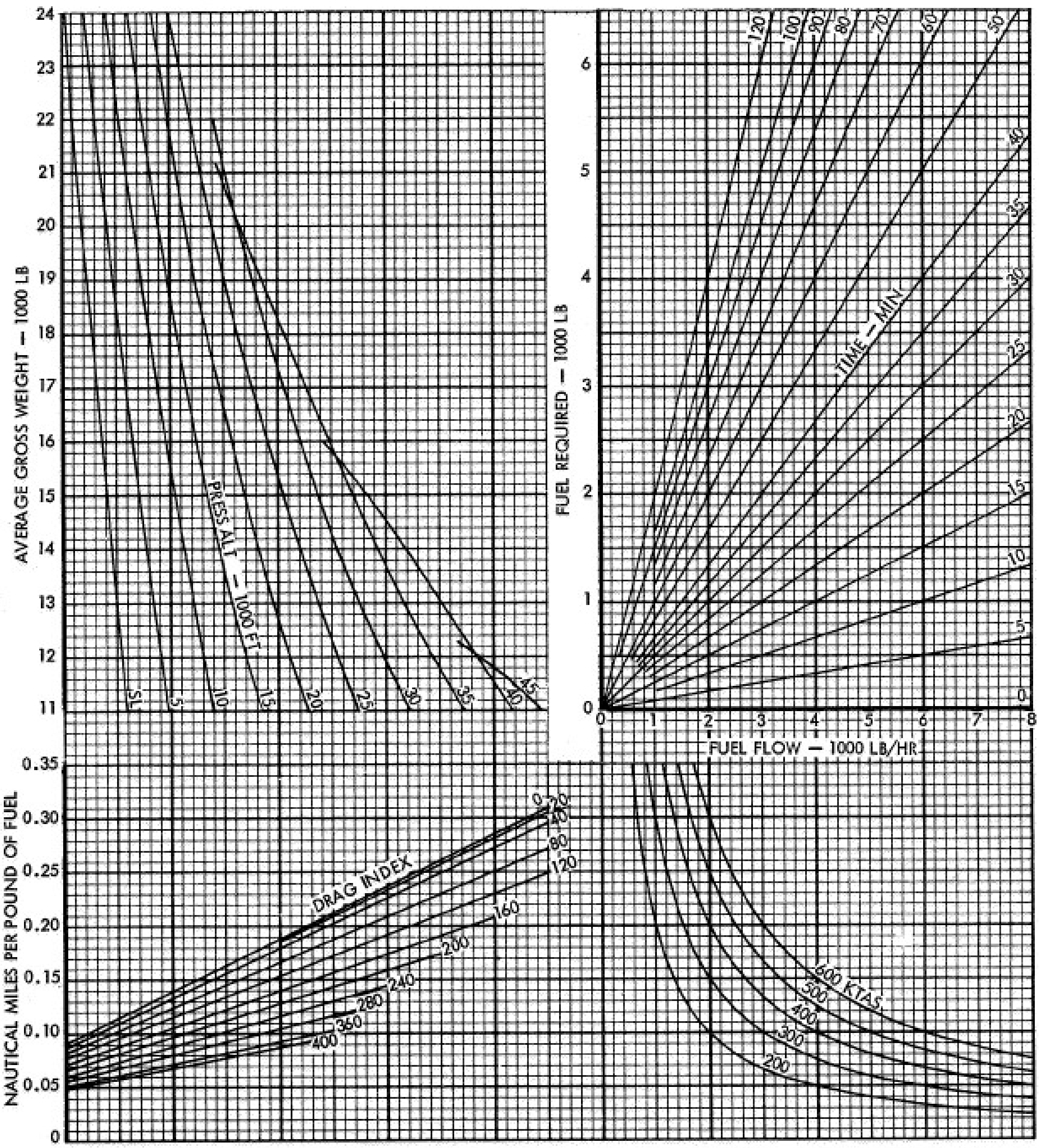
CONSTANT ALTITUDE CRUISE (FLAPS UP)

LONG RANGE SPEED

SPECIFIC RANGE, FUEL FLOW, AND FUEL REQUIRED

DRAG INDEX 0 TO 400





F-5 1-529(20)

FA4-6 (Sheet 2).

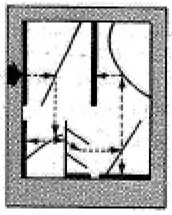
MODEL: F-5E/F
DATE: 1 MARCH 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

CONSTANT ALTITUDE CRUISE (FLAPS UP)

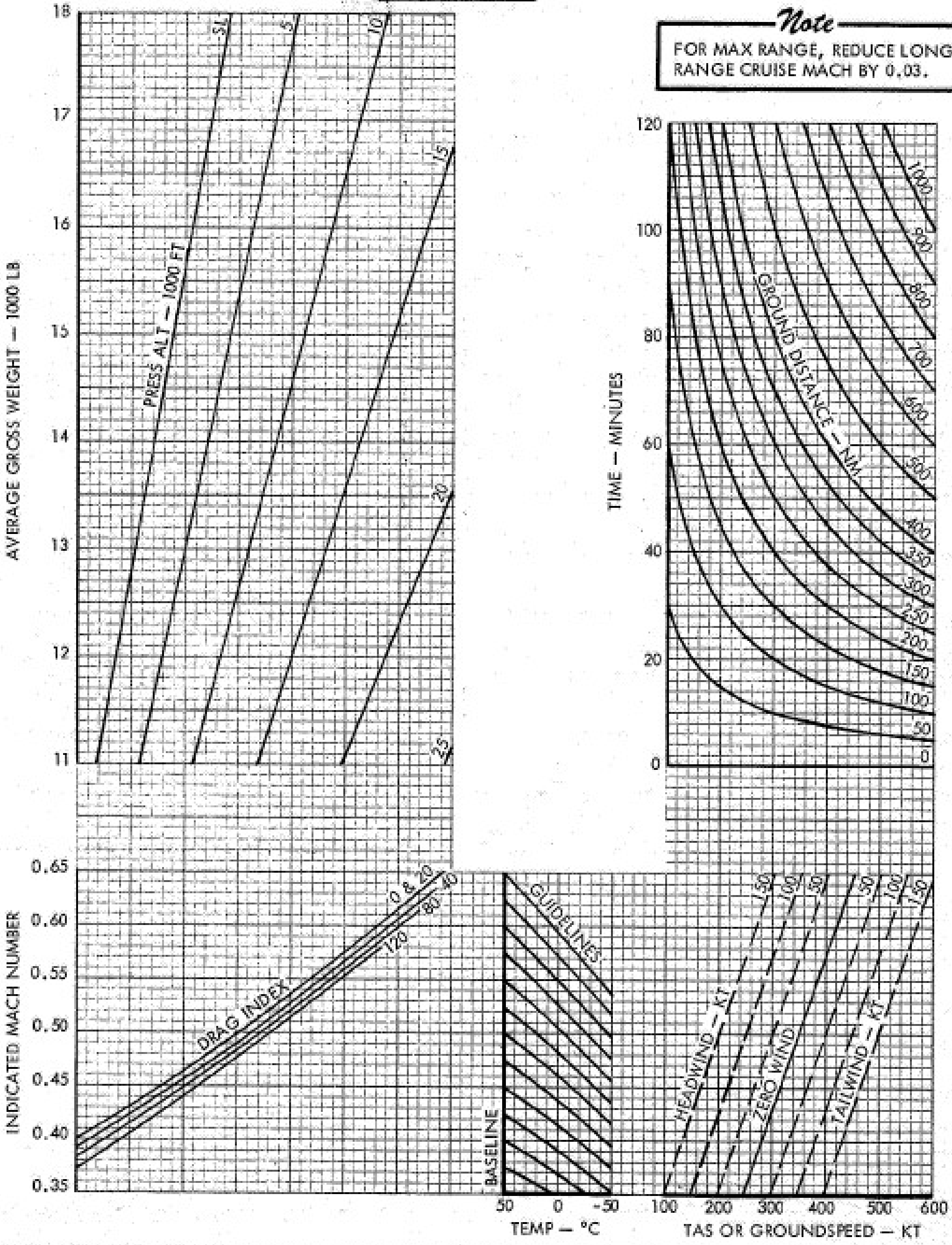
LONG RANGE SPEED
INDICATED MACH NUMBER, TRUE AIRSPEED, GROUNDSPEED, AND TIME
DRAG INDEX 0 TO 120

SINGLE ENGINE



Note

FOR MAX RANGE, REDUCE LONG RANGE CRUISE MACH BY 0.03.



STANDARD DAY									
ALT — 1000 FT	SL	5	10	15	20	25	30	35	36,089 & ABOVE
TEMP — °C	15.0	5.1	-4.8	-14.7	-24.6	-34.5	-44.4	-54.3	-56.5

SPEED
——— GROUND OR AIR
— — GROUND

F-5 1-577(20)

FA4-7 (Sheet 1).

MODEL: F-5E/F
DATE: 1 MARCH 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

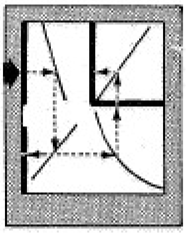
CONSTANT ALTITUDE CRUISE
(FLAPS UP)

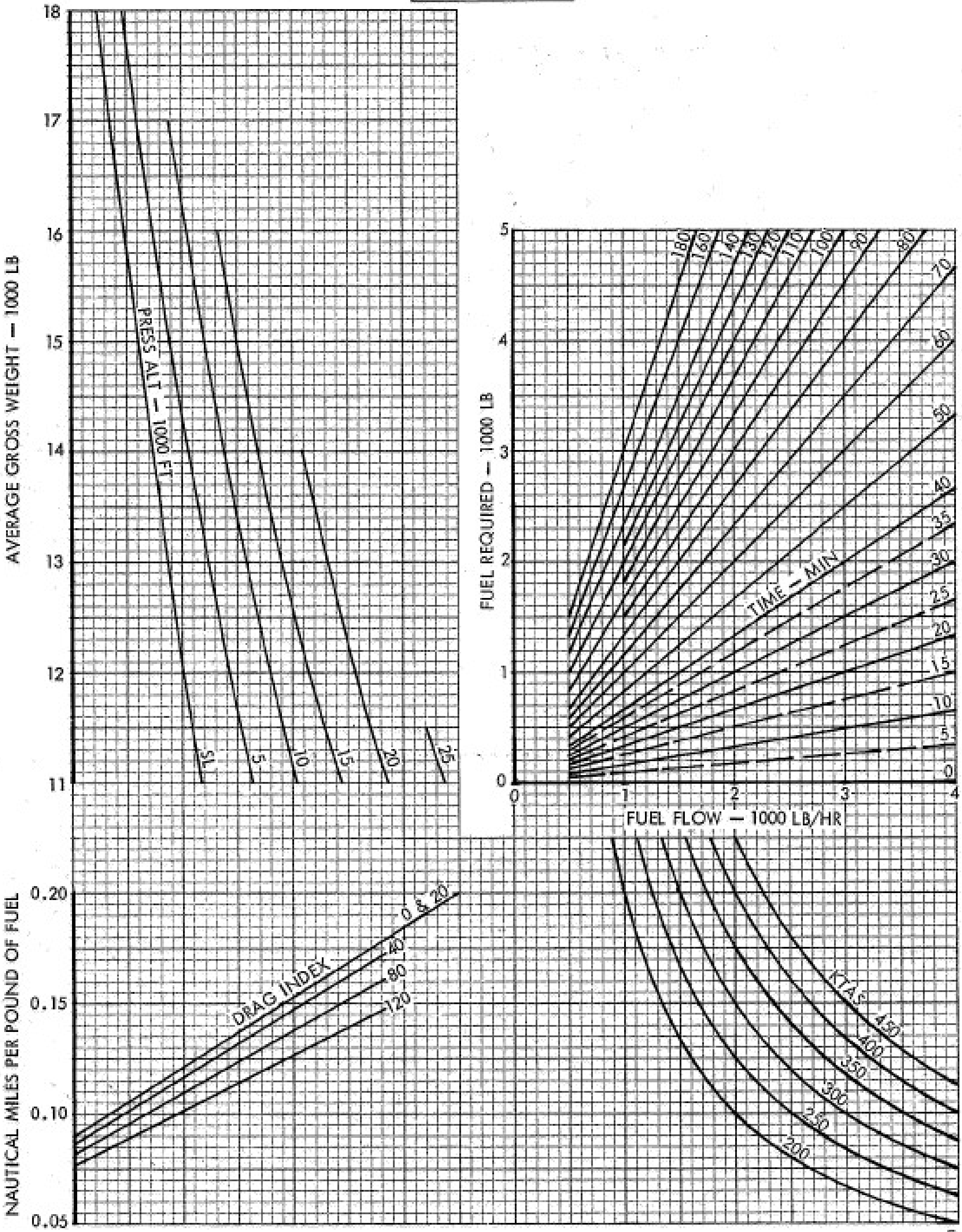
LONG RANGE SPEED

SPECIFIC RANGE, FUEL FLOW, AND FUEL REQUIRED

DRAG INDEX 0 TO 120

SINGLE ENGINE





F-5 1-578(20)

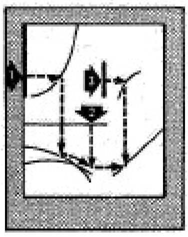
FA4-7 (Sheet 2).

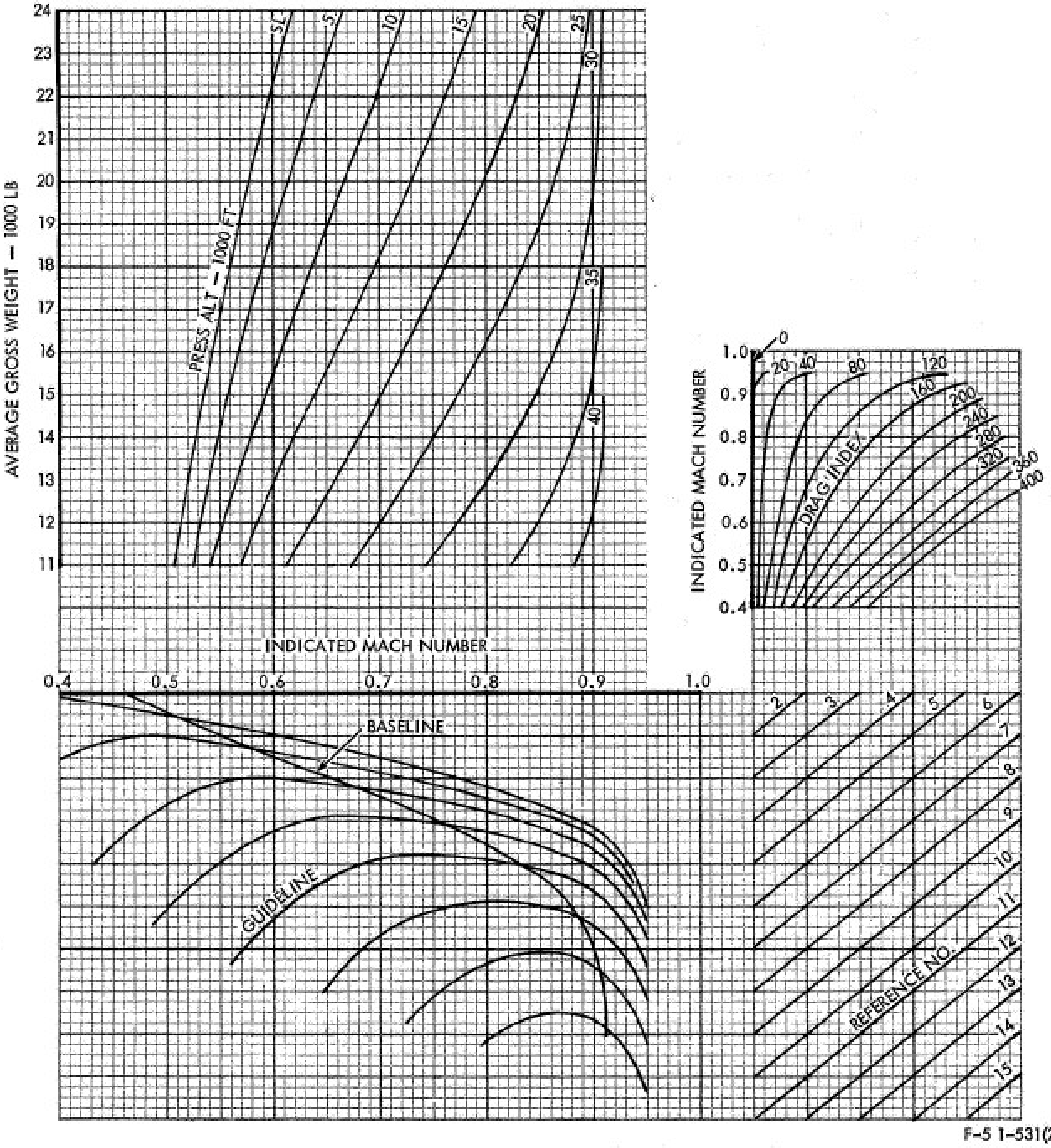
MODEL: F-5E/F
DATE: 1 MARCH 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

NAUTICAL MILES PER POUND OF FUEL (FLAPS UP)

INDICATED MACH NUMBER
AND
REFERENCE NUMBER



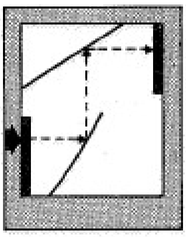


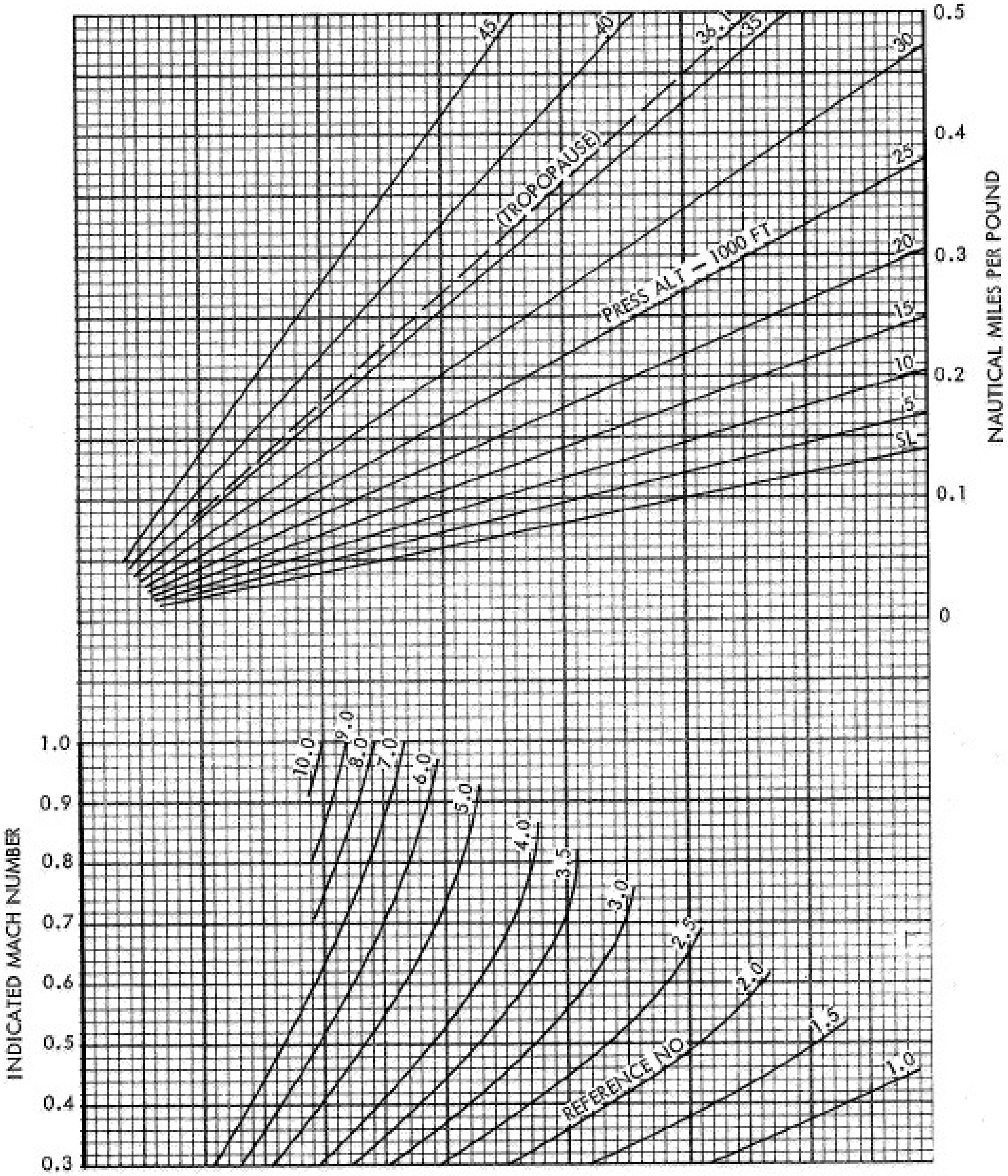
FA4-8 (Sheet 1).

MODEL: F-5E/F
DATE: 1 MARCH 1976
DATA BASIS: **FLIGHT TEST**
ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

NAUTICAL MILES PER POUND OF FUEL (FLAPS UP)

NAUTICAL MILES PER POUND





F-5 1-533(20)

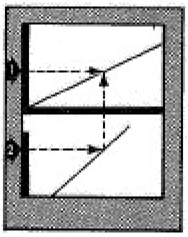
FA4-8 (Sheet 2).

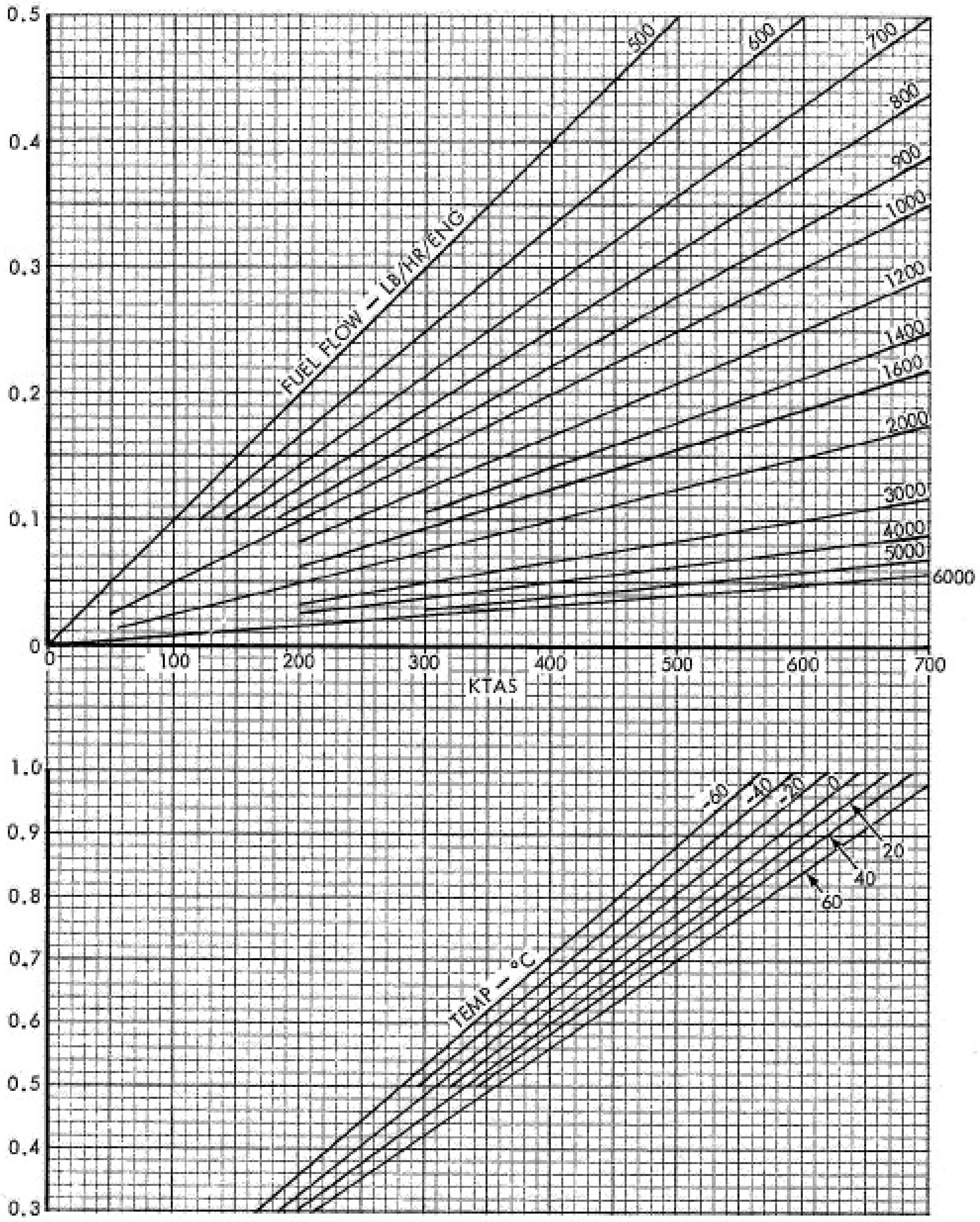
MODEL: F-5E/F
DATE: 1 MARCH 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2)J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

NAUTICAL MILES PER POUND OF FUEL

FUEL FLOW AND TRUE AIRSPEED





STANDARD DAY									
ALT — 1000 FT	SL	5	10	15	20	25	30	35	36,089 & ABOVE
TEMP — °C	15.0	5.1	-4.8	-14.7	-24.6	-34.5	-44.4	-54.3	-56.5

F-5 1-534(20)

FA4-8 (Sheet 3).

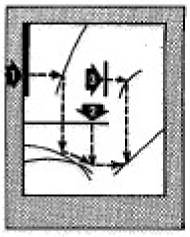
MODEL: F-5E/F
DATE: 1 MARCH 1976
DATA BASIS: **FLIGHT TEST**

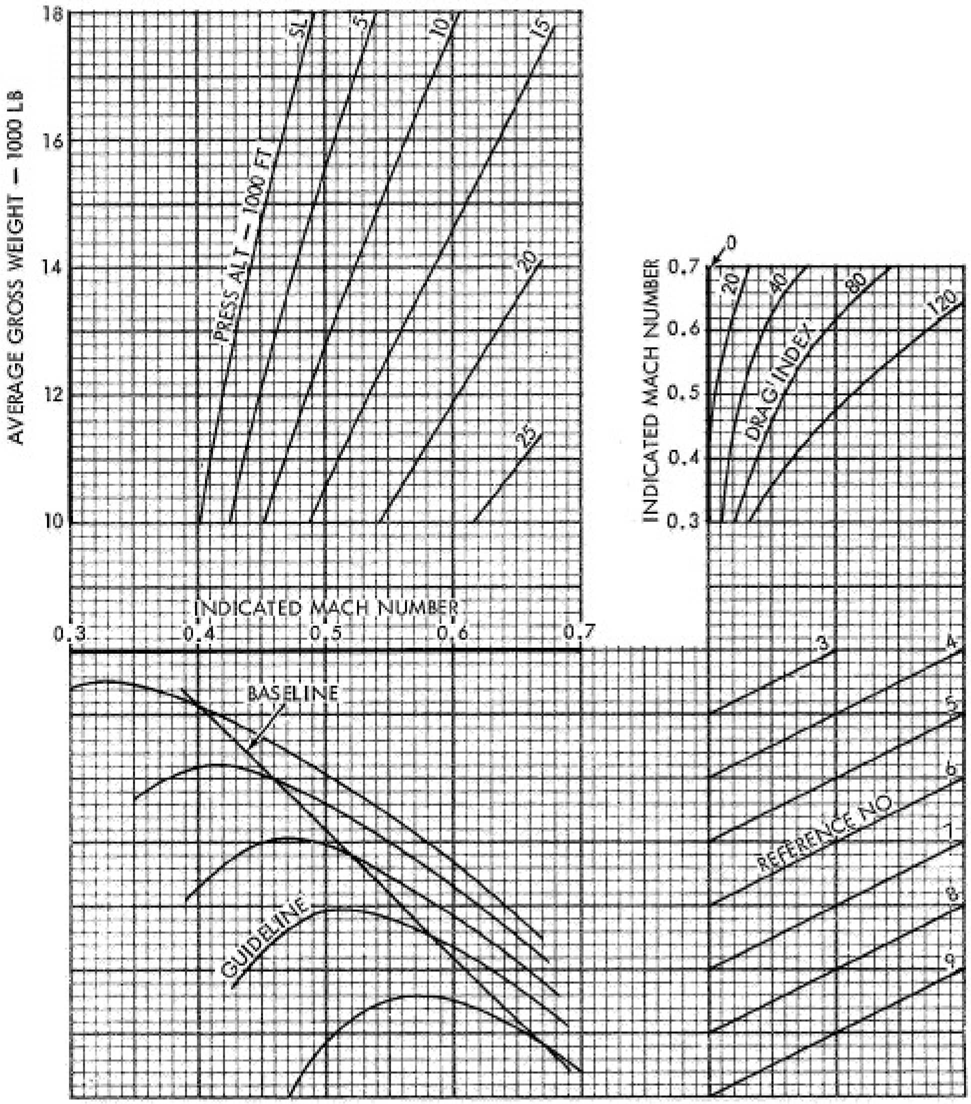
ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

NAUTICAL MILES PER POUND OF FUEL (FLAPS UP)

INDICATED MACH NUMBER AND REFERENCE NUMBER

SINGLE ENGINE





F-5 1-591(20)

FA4-9 (Sheet 1).

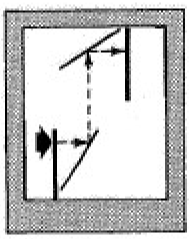
MODEL: F-5E/F
DATE: 1 MARCH 1976
DATA BASIS: **FLIGHT TEST**

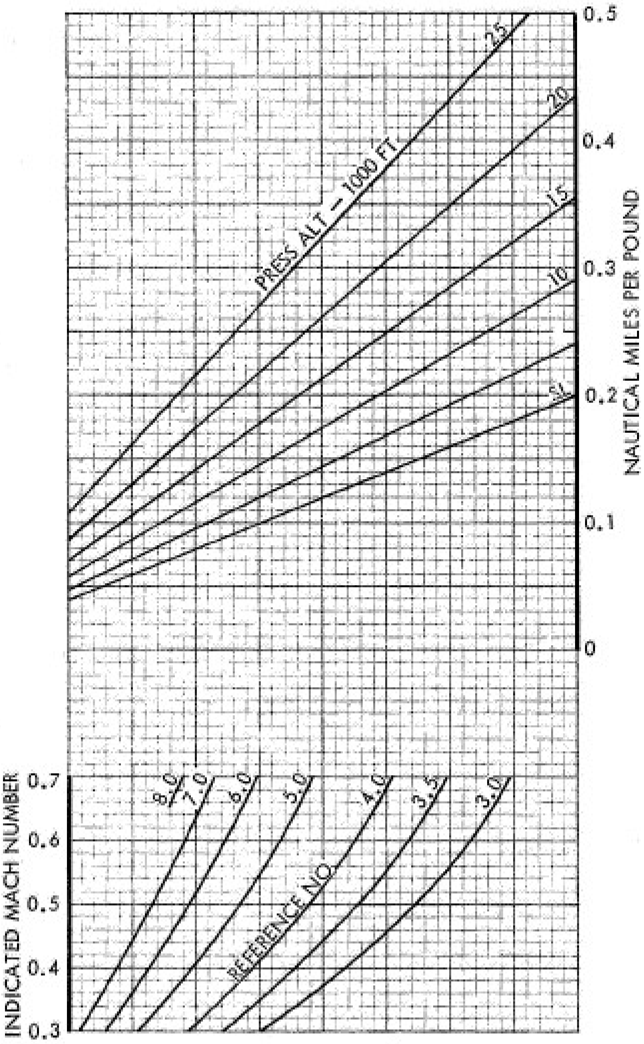
ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

NAUTICAL MILES PER POUND OF FUEL (FLAPS UP)

NAUTICAL MILES PER POUND

SINGLE ENGINE





F-5 1-518(20)

FA4-9 (Sheet 2).

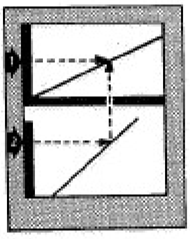
MODEL: F-5E/F
DATE: 1 MARCH 1976
DATA BASIS: **FLIGHT TEST**

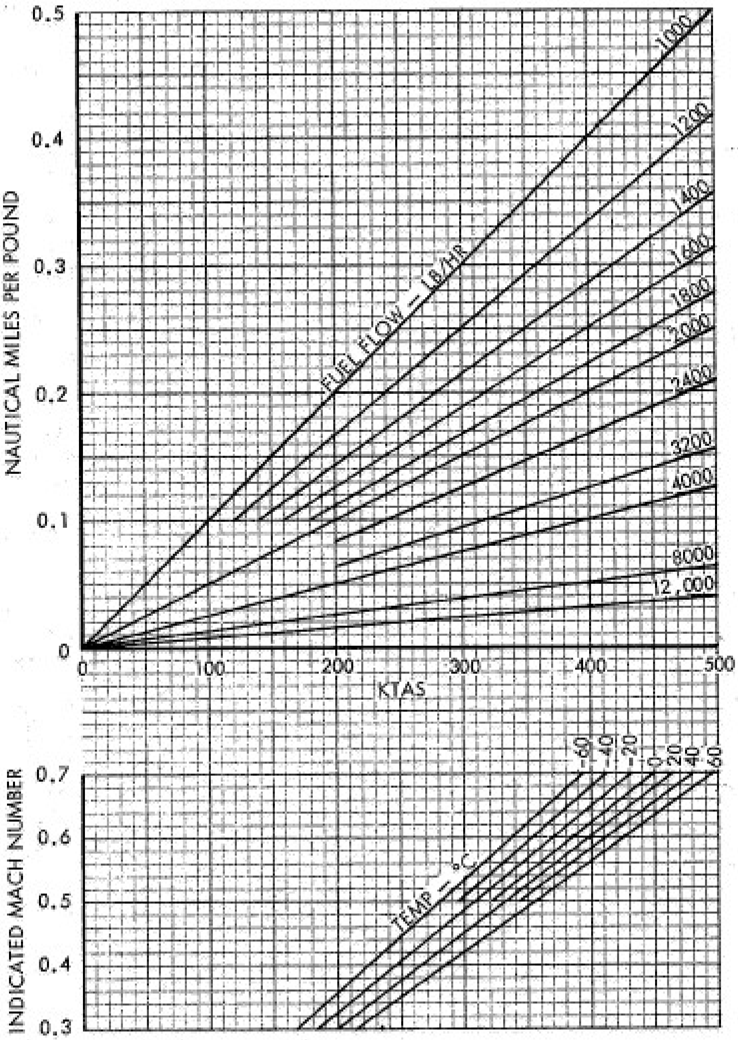
ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

NAUTICAL MILES PER POUND OF FUEL

FUEL FLOW AND TRUE AIRSPEED

SINGLE ENGINE





STANDARD DAY									
ALT — 1000 FT	SL	5	10	15	20	25	30	35	36,089 & ABOVE
TEMP — °C	15.0	5.1	-4.8	-14.7	-24.6	-34.5	-44.4	-54.3	-56.5

F-5 1-569(20)

FA4-9 (Sheet 3).

DIVERSION RANGE

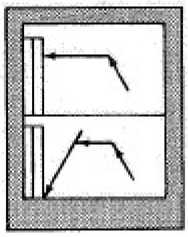
MODEL: F-5E
DATE: 1 DECEMBER 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

TO ARRIVE AT DESTINATION WITH 300 LB OF FUEL REMAINING

AIM-9 + (5) PYLONS

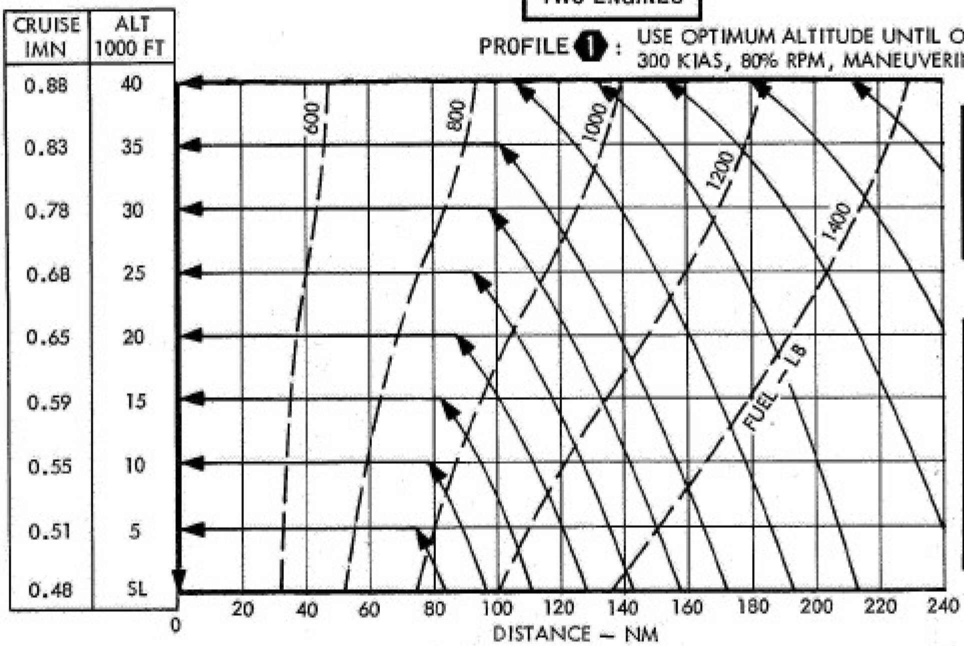
STANDARD DAY ZERO WIND



E

TWO ENGINES

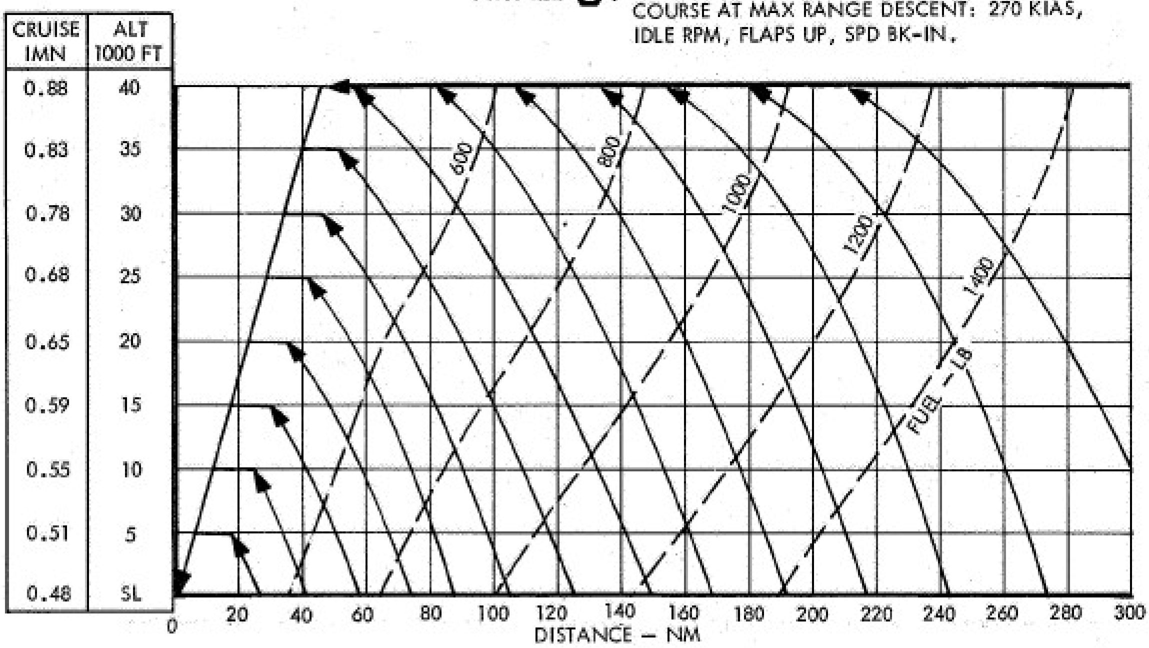
PROFILE 1: USE OPTIMUM ALTITUDE UNTIL OVER BASE. DESCEND AT 300 KIAS, 80% RPM, MANEUVERING FLAPS, SPD BK 45°.



LEGEND
- ——— CLIMB-CRUISE FLIGHT PATH GUIDELINES
- – – – FUEL REQUIRED OR REMAINING

Note
- CLIMB AT 330 KIAS OR 0.88 IMN, WHICHEVER IS LOWER, WITH MILITARY THRUST.
- CLIMB AND CRUISE WITH FLAPS UP.
- WITH MORE THAN 1400 POUNDS OF FUEL, CRUISE AT 0.88 IMN, 38,000 FT.

PROFILE 2: USE OPTIMUM ALTITUDE AND DESCEND ON COURSE AT MAX RANGE DESCENT: 270 KIAS, IDLE RPM, FLAPS UP, SPD BK-IN.



PROFILE 1: FUEL IS INCLUDED FOR CLIMB TO OPTIMUM ALTITUDE AND PENETRATION DESCENT AT DESTINATION. NO DISTANCE CREDIT FOR DESCENT TO DESTINATION.

PROFILE 2: FUEL IS INCLUDED FOR CLIMB TO OPTIMUM ALTITUDE AND MAXIMUM RANGE DESCENT TO DESTINATION; RANGE INCLUDES DISTANCE FOR ON-COURSE DESCENT TO DESTINATION.

F-5 1-589(1)C

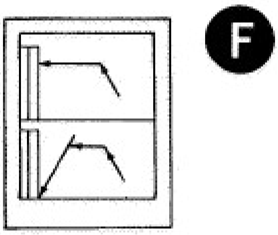
FA4-10 (Sheet 1).

MODEL: F-5F
DATE: 1 AUGUST 1977
DATA BASIS: **FLIGHT TEST**
ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

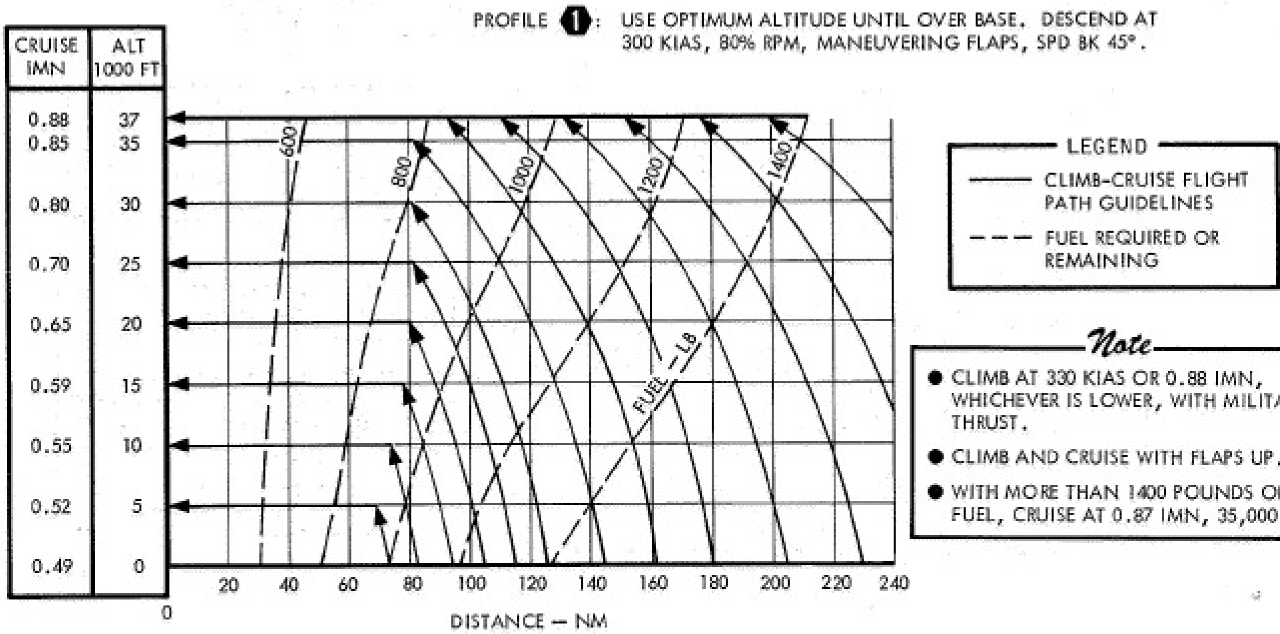
DIVERSION RANGE

TO ARRIVE AT DESTINATION WITH 300 LB OF FUEL REMAINING
AIM-9 + (5) PYLONS
STANDARD DAY ZERO WIND

TWO ENGINES



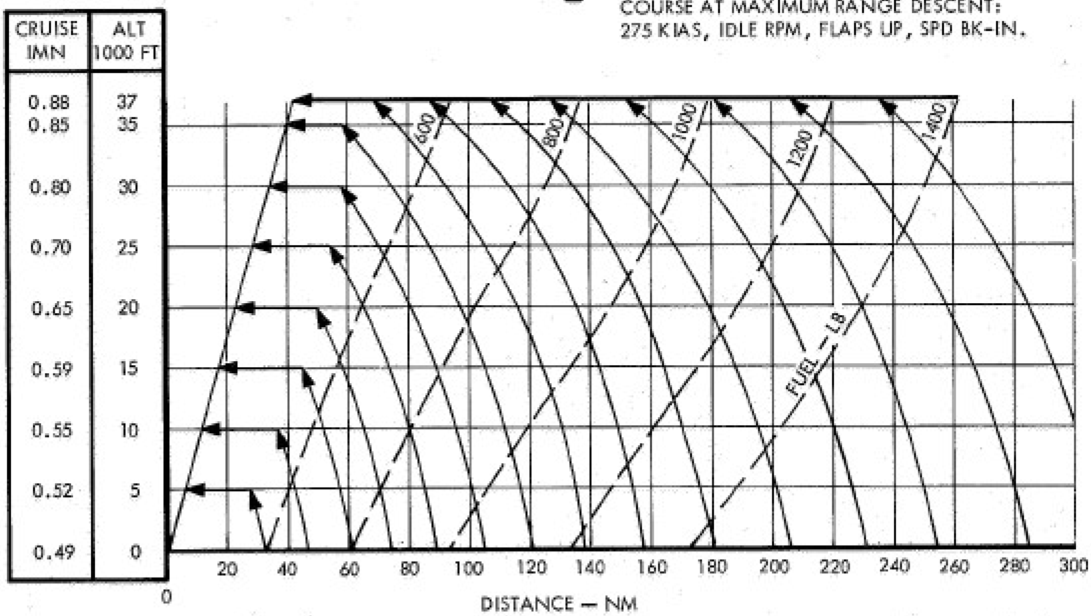
PROFILE 1: USE OPTIMUM ALTITUDE UNTIL OVER BASE. DESCEND AT 300 KIAS, 80% RPM, MANEUVERING FLAPS, SPD BK 45°.



Note

- CLIMB AT 330 KIAS OR 0.88 IMN, WHICHEVER IS LOWER, WITH MILITARY THRUST.
- CLIMB AND CRUISE WITH FLAPS UP.
- WITH MORE THAN 1400 POUNDS OF FUEL, CRUISE AT 0.87 IMN, 35,000 FT.

PROFILE 2: USE OPTIMUM ALTITUDE AND DESCEND ON COURSE AT MAXIMUM RANGE DESCENT: 275 KIAS, IDLE RPM, FLAPS UP, SPD BK-IN.



PROFILE 1: FUEL IS INCLUDED FOR CLIMB TO OPTIMUM ALTITUDE AND PENETRATION DESCENT AT DESTINATION. NO DISTANCE CREDIT FOR DESCENT TO DESTINATION.

PROFILE 2: FUEL IS INCLUDED FOR CLIMB TO OPTIMUM ALTITUDE AND MAXIMUM RANGE DESCENT TO DESTINATION. RANGE INCLUDES DISTANCE FOR ON-COURSE DESCENT TO DESTINATION.

F-5 1-589(2)C

FA4-10 (Sheet 2).

MODEL: F-5E
DATE: 1 AUGUST 1977
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

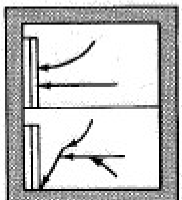
DIVERSION RANGE

TO ARRIVE AT DESTINATION WITH 300 LB OF FUEL REMAINING

AIM-9 + (5) PYLONS

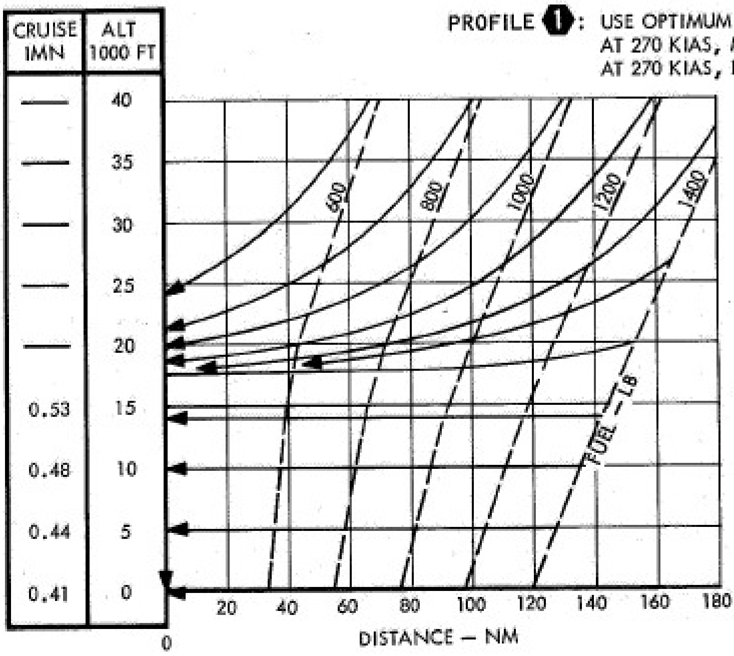
STANDARD DAY ZERO WIND

SINGLE ENGINE – WITHOUT AB



E

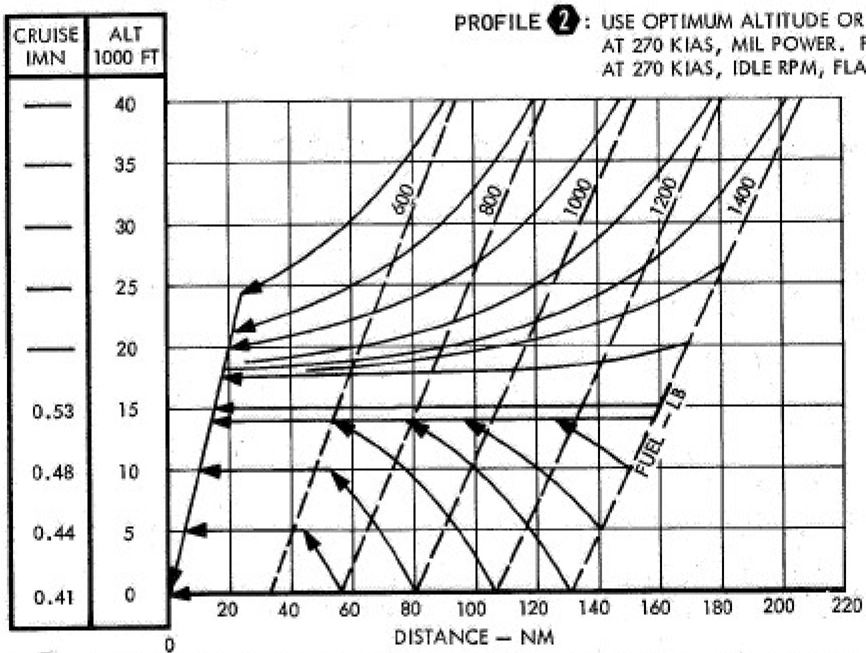
PROFILE ❶: USE OPTIMUM ALTITUDE OR DESCEND (IF REQUIRED) AT 270 KIAS, MIL POWER. FINAL DESCENT OVER BASE AT 270 KIAS, IDLE RPM, FLAPS UP, SPD BK-IN.



LEGEND
- ——— DESCENT OR CLIMB-CRUISE FLIGHT PATH GUIDELINE
- – – – FUEL REQUIRED OR REMAINING

Note
- CLIMB (IF REQUIRED) AT 245 KIAS WITH MIL THRUST.
- IF MIL POWER TIME LIMITATION OF 30 MIN IS EXCEEDED, USE MAXIMUM CONTINUOUS POWER (EGT = 650°C).
- CLIMB AND CRUISE WITH FLAPS UP.
- WITH MORE THAN 1400 LB OF FUEL, CRUISE AT 0.54 IMN, 12,000 FT.

PROFILE ❷: USE OPTIMUM ALTITUDE OR DESCEND (IF REQUIRED) AT 270 KIAS, MIL POWER. FINAL DESCENT ON COURSE AT 270 KIAS, IDLE RPM, FLAPS UP, SPD BK-IN.



PROFILE ❶: FUEL IS INCLUDED FOR DESCENT TO OPTIMUM ALTITUDE AND DESCENT AT DESTINATION. NO DISTANCE CREDIT FOR DESCENT TO DESTINATION.

PROFILE ❷: FUEL IS INCLUDED FOR CLIMB OR DESCENT TO OPTIMUM ALTITUDE AND MAXIMUM RANGE DESCENT TO DESTINATION; RANGE INCLUDES DISTANCE FOR ON-COURSE DESCENT TO DESTINATION.

F-5 1-587(1)D

FA4-10 (Sheet 3).

MODEL: F-5F
DATE: 1 AUGUST 1977
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

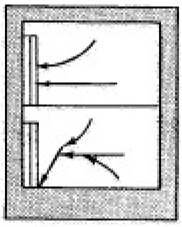
DIVERSION RANGE

TO ARRIVE AT DESTINATION WITH
300 LB OF FUEL REMAINING

AIM-9 + (5) PYLONS

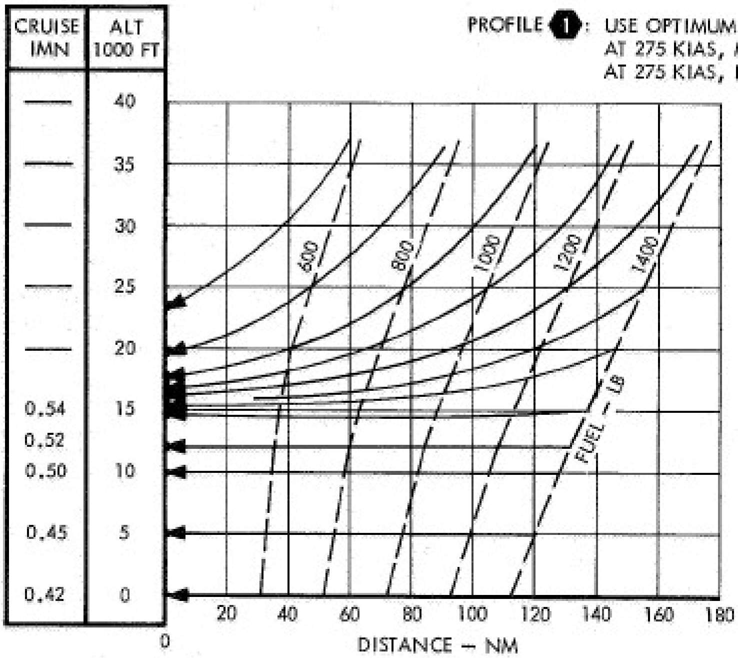
STANDARD DAY ZERO WIND

SINGLE ENGINE – WITHOUT AB



F

PROFILE 1: USE OPTIMUM ALTITUDE OR DESCEND (IF REQUIRED) AT 275 KIAS, MIL POWER. FINAL DESCENT OVER BASE AT 275 KIAS, IDLE RPM, FLAPS UP, SPD BK-IN.

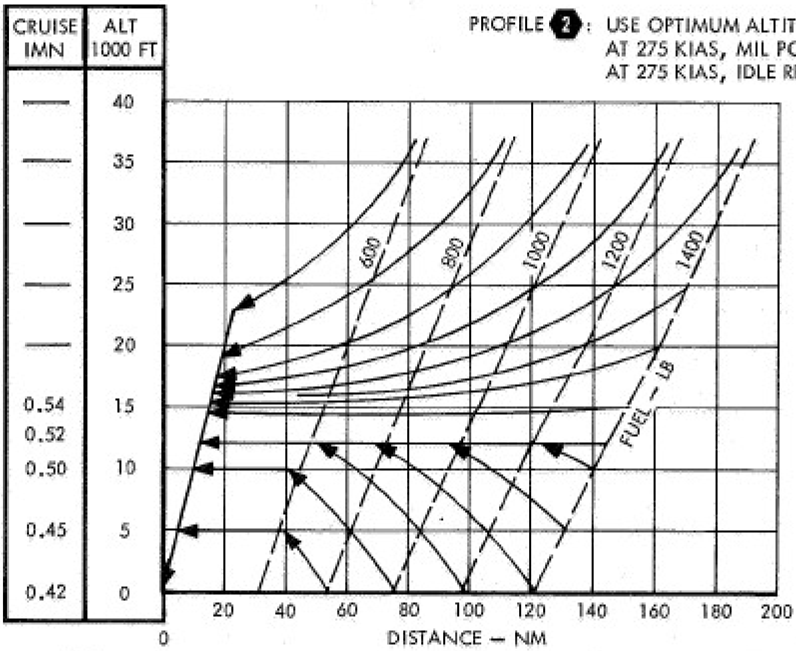


LEGEND
— DESCENT OR CLIMB-CRUISE FLIGHT PATH GUIDELINE
– – – FUEL REQUIRED OR REMAINING

Note

- CLIMB (IF REQUIRED) AT 245 KIAS WITH MIL THRUST.
- IF MIL POWER TIME LIMITATION OF 30 MIN IS EXCEEDED, USE MAXIMUM CONTINUOUS POWER (EGT=650°C).
- CLIMB AND CRUISE WITH FLAPS UP.
- WITH MORE THAN 1400 LB OF FUEL, CRUISE AT 0.52 IMN, 10,000 FT.

PROFILE 2: USE OPTIMUM ALTITUDE OR DESCEND (IF REQUIRED) AT 275 KIAS, MIL POWER. FINAL DESCENT ON COURSE AT 275 KIAS, IDLE RPM, FLAPS UP, SPD BK-IN.



PROFILE 1: FUEL IS INCLUDED FOR DESCENT TO OPTIMUM ALTITUDE AND DESCENT AT DESTINATION. NO DISTANCE CREDIT FOR DESCENT TO DESTINATION.

PROFILE 2: FUEL IS INCLUDED FOR CLIMB OR DESCENT TO OPTIMUM ALTITUDE AND MAXIMUM RANGE DESCENT TO DESTINATION; RANGE INCLUDES DISTANCE FOR ON-COURSE DESCENT TO DESTINATION.

F-5 1-587(2)C

FA4-10 (Sheet 4).

MODEL: F-5E
DATE: 1 AUGUST 1977
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

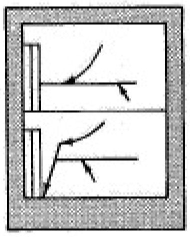
DIVERSION RANGE

TO ARRIVE AT DESTINATION WITH 300 LB OF FUEL REMAINING

AIM-9 + (5) PYLONS

STANDARD DAY ZERO WIND

SINGLE ENGINE — PARTIAL AB

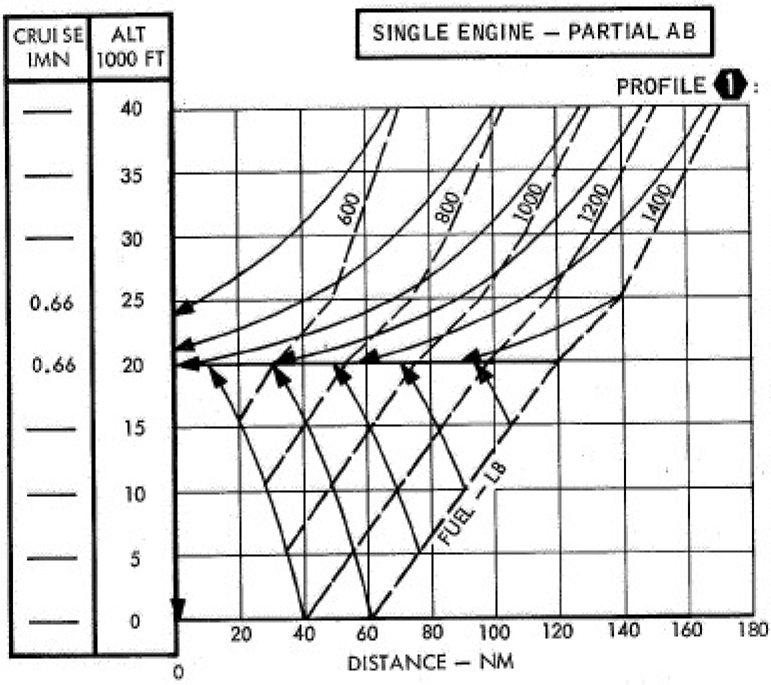


E

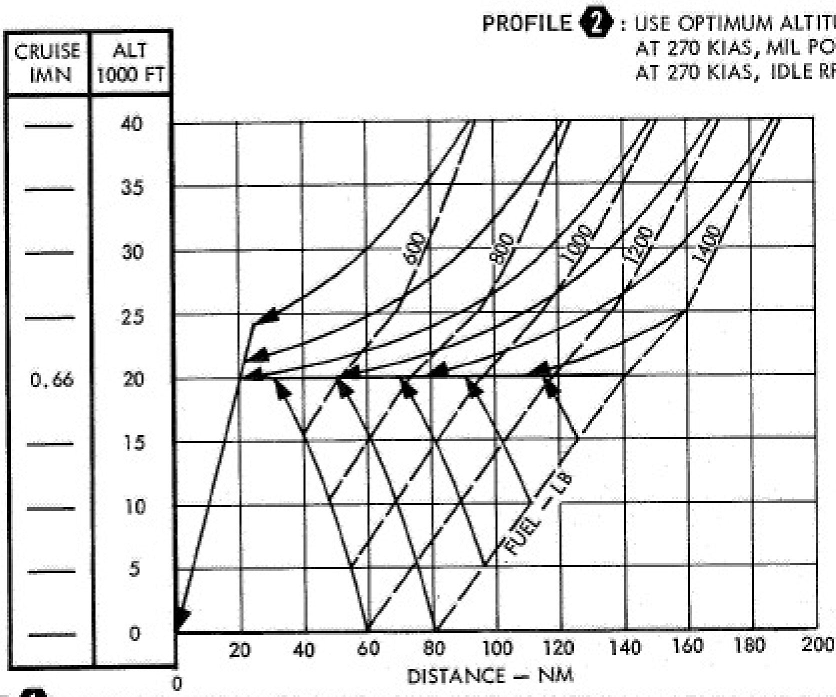
PROFILE 1: USE OPTIMUM ALTITUDE OR DESCEND (IF REQUIRED) AT 270 KIAS, MIL POWER. FINAL DESCENT OVER BASE AT 270 KIAS, IDLE RPM, FLAPS UP, SPD BK — IN.

LEGEND
- ——— DESCENT OR CLIMB-CRUISE FLIGHT PATH GUIDELINE
- – – – FUEL REQUIRED OR REMAINING

Note
- CLIMB (IF REQUIRED) AT 290 KIAS WITH MAX THRUST.
- CLIMB AND CRUISE WITH FLAPS UP.
- WITH MORE THAN 1400 LB OF FUEL, CRUISE AT 0.64 IMN, 20,000 FT.
- PARTIAL AB TIME LIMITATION IS 15 MIN.



PROFILE 2: USE OPTIMUM ALTITUDE OR DESCEND (IF REQUIRED) AT 270 KIAS, MIL POWER. FINAL DESCENT ON COURSE AT 270 KIAS, IDLE RPM, FLAPS UP, SPD BK-IN.

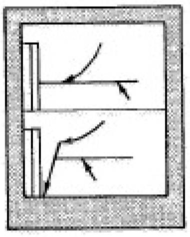


PROFILE 1: FUEL IS INCLUDED FOR CLIMB OR DESCENT TO OPTIMUM ALTITUDE AND DESCENT AT DESTINATION. NO DISTANCE CREDIT FOR DESCENT TO DESTINATION.

PROFILE 2: FUEL IS INCLUDED FOR CLIMB OR DESCENT TO OPTIMUM ALTITUDE AND MAXIMUM RANGE DESCENT TO DESTINATION; RANGE INCLUDES DISTANCE FOR ON-COURSE DESCENT TO DESTINATION.

F-5 1-585(1)D

FA4-10 (Sheet 5).



F

MODEL: F-5F
DATE: 1 AUGUST 1977
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

DIVERSION RANGE

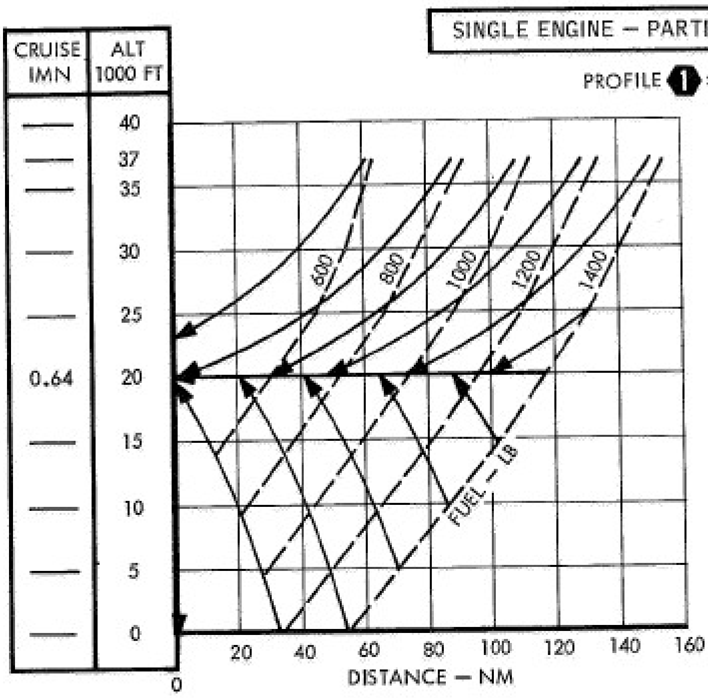
TO ARRIVE AT DESTINATION WITH 300 LB OF FUEL REMAINING

AIM-9 + (5) PYLONS

STANDARD DAY ZERO WIND

SINGLE ENGINE – PARTIAL AB

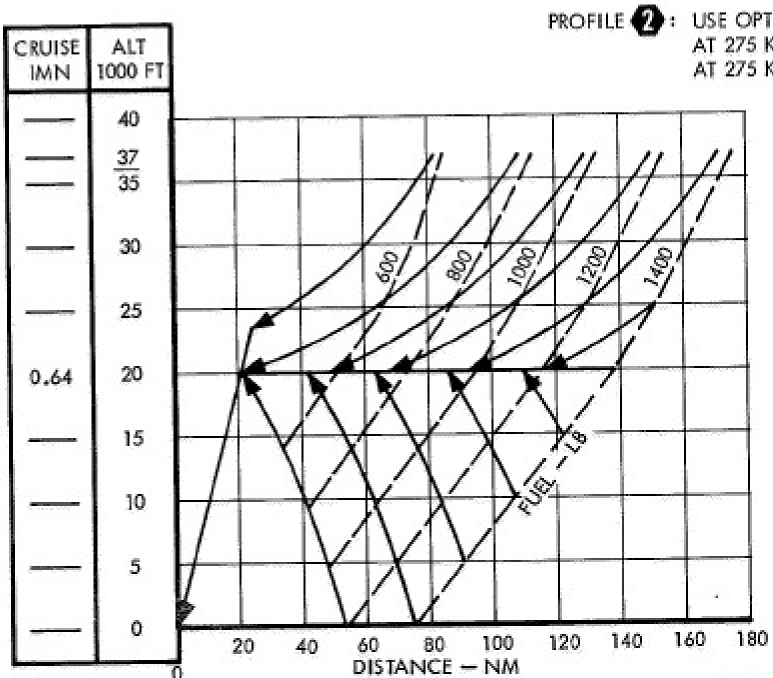
PROFILE 1: USE OPTIMUM ALTITUDE OR DESCEND (IF REQUIRED) AT 275 KIAS, MIL POWER. FINAL DESCENT OVER BASE AT 275 KIAS, IDLE RPM, FLAPS UP, SPD BK-IN.



LEGEND
- ——— DESCENT OR CLIMB-CRUISE FLIGHT PATH GUIDELINES
- – – – FUEL REQUIRED OR REMAINING

Note
- CLIMB (IF REQUIRED) AT 290 KIAS WITH MAX THRUST.
- CLIMB AND CRUISE WITH FLAPS UP.
- WITH MORE THEN 1400 LB OF FUEL, CRUISE AT 0.62 IMN, 20,000 FT.
- PARTIAL AB TIME LIMITATION IS 15 MIN.

PROFILE 2: USE OPTIMUM ALTITUDE OR DESCEND (IF REQUIRED) AT 275 KIAS, MIL POWER. FINAL DESCENT ON COURSE AT 275 KIAS, IDLE RPM, FLAPS UP, SPD BK-IN.

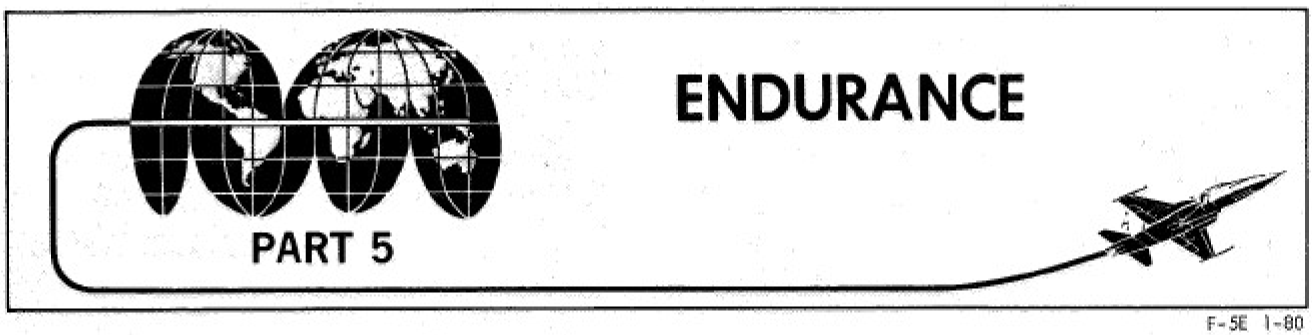


PROFILE 1: FUEL IS INCLUDED FOR CLIMB OR DESCENT TO OPTIMUM ALTITUDE AND DESCENT AT DESTINATION. NO DISTANCE CREDIT FOR DESCENT TO DESTINATION.

PROFILE 2: FUEL IS INCLUDED FOR CLIMB OR DESCENT TO OPTIMUM ALTITUDE AND MAXIMUM RANGE DESCENT TO DESTINATION; RANGE INCLUDES DISTANCE FOR ON-COURSE DESCENT TO DESTINATION.

F-5 1-585(2)C

FA4-10 (Sheet 6).



F-5E 1-80

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Page numbers underlined denote charts.

ENDURANCE CHARTS

Endurance charts determine the optimum mach number and fuel required to loiter at a given altitude for a specific period of time. A correction grid to gross weight for bank angle and a temperature correction grid (hotter-than-standard conditions) to fuel flow are provided for optional use.

NOTE

> The effects of temperature for colder-than-standard day conditions are considered negligible. Use standard day (baseline) for temperatures below standard day.

The altitude for maximum loiter time is defined in the charts by the drag index curves titled "optimum maximum endurance altitude" contained in the gross weight grid. The endurance chart for two-engine operation provides data for drag indices of 0 thru 400. The single-engine endurance chart provides data for drag indices of 0 thru 120. The data on the endurance charts are based on flaps up below a drag index of 80 and on cruise flaps at a drag index of 80 and above.

USE

Enter the appropriate two-engine or single-engine chart (FA5-1 or FA5-2) with gross weight. If the loiter period requires turning flight, gross weight should be corrected for bank angle. To use the bank angle correction grid, enter with gross weight and contour the nearest guideline to the right while simultaneously entering the bank angle scale with desired degree of bank angle and projecting up. At the point of intersection of the two projections, proceed left and read gross weight corrected for bank angle.

Gross weight (corrected for bank angle, if required) is then projected right from the gross weight scale of the chart to the pressure altitude. If maximum loiter time is desired, stop momentarily at the optimum maximum endurance altitude drag index curve (interpolate, if necessary). Mark this position location on the chart for further use.

From the point of intersection with pressure altitude, proceed up to the configuration drag index in the upper left grid of the chart, then left to read the indicated mach number for loiter. Return to the plotted point intersection of the gross weight and pressure altitude and proceed down to the drag index at the lower left portion of the chart, then right to the gross weight curve. From this point proceed up to the baseline of the temperature correction grid (standard day). For hotter-than-standard day condition, contour the guidelines to the temperature increase. (If no increase is required, proceed directly thru.) Fuel flow can be read while proceeding up to the desired loiter time. Project right to read fuel required for loiter.

If loiter fuel is already known, project left from the fuel required scale and simultaneously intersect the vertical plot projected from the temperature grid to read loiter time.

For loiter times of long duration (more than 10 minutes) greater accuracy requires use of average gross weight during loiter to calculate the fuel required. To obtain average loiter weight, the fuel required to loiter must first be determined based on gross weight at start or end of loiter and then is recalculated based on start or end gross weight, decreased or increased, respectively, by half the calculated loiter fuel.

SAMPLE PROBLEM

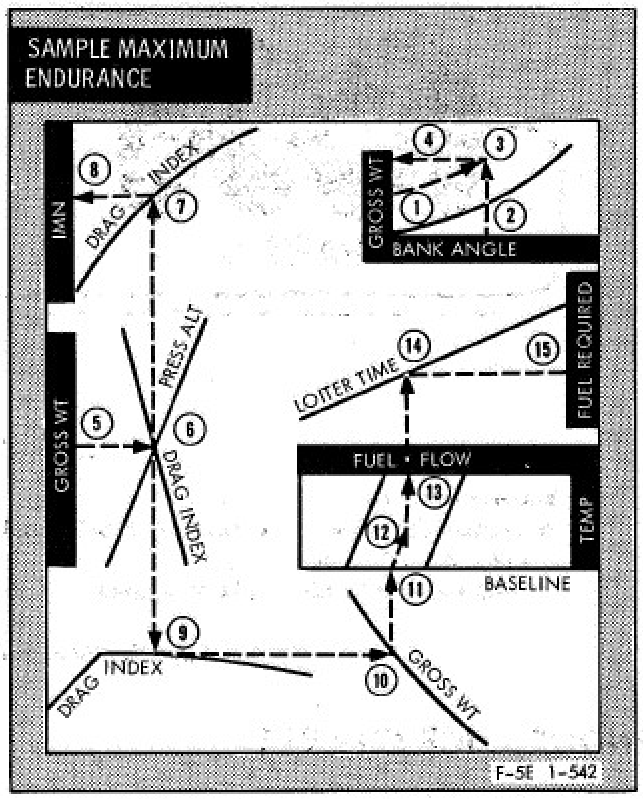
Given:

A. End cruise gross weight: 15,900 lb.
B. Desired two-engine loiter time with bank angle of 20 degrees: 10 min.
C. Loiter pressure altitude: 25,000 ft.
D. Drag Index: 120.
E. Temperature (at altitude): 10°C hotter-than-standard.

Calculate:

A. Indicated mach number and fuel required to 10-minute loiter.
B. Use Maximum Endurance — Time, Fuel, Mach Number, and Optimum Altitude — Drag Index 0 to 400 chart FA5-1.

①	Gross Wt	15,900 lb
②	Bank Angle	20 deg
③	Intersection	———
④	Gross Wt (corrected)	17,000 lb
⑤	Gross Wt (corrected)	17,000 lb
⑥	Press Alt	25,000 ft
⑦	Drag Index	120



NOTE

If optimum maximum endurance altitude is desired, intersect optimum maximum endurance altitude at 120 drag index (interpolate) and continue plot in similar manner.

⑧	IMN	0.65
⑨	Drag Index	120
⑩	Gross Wt (corrected)	17,000 lb
⑪	Baseline	———
⑫	Temp	10°C (hotter)
⑬	Fuel Flow	48.5 lb/min
⑭	Loiter Time	10 min
⑮	Fuel Required	470 lb

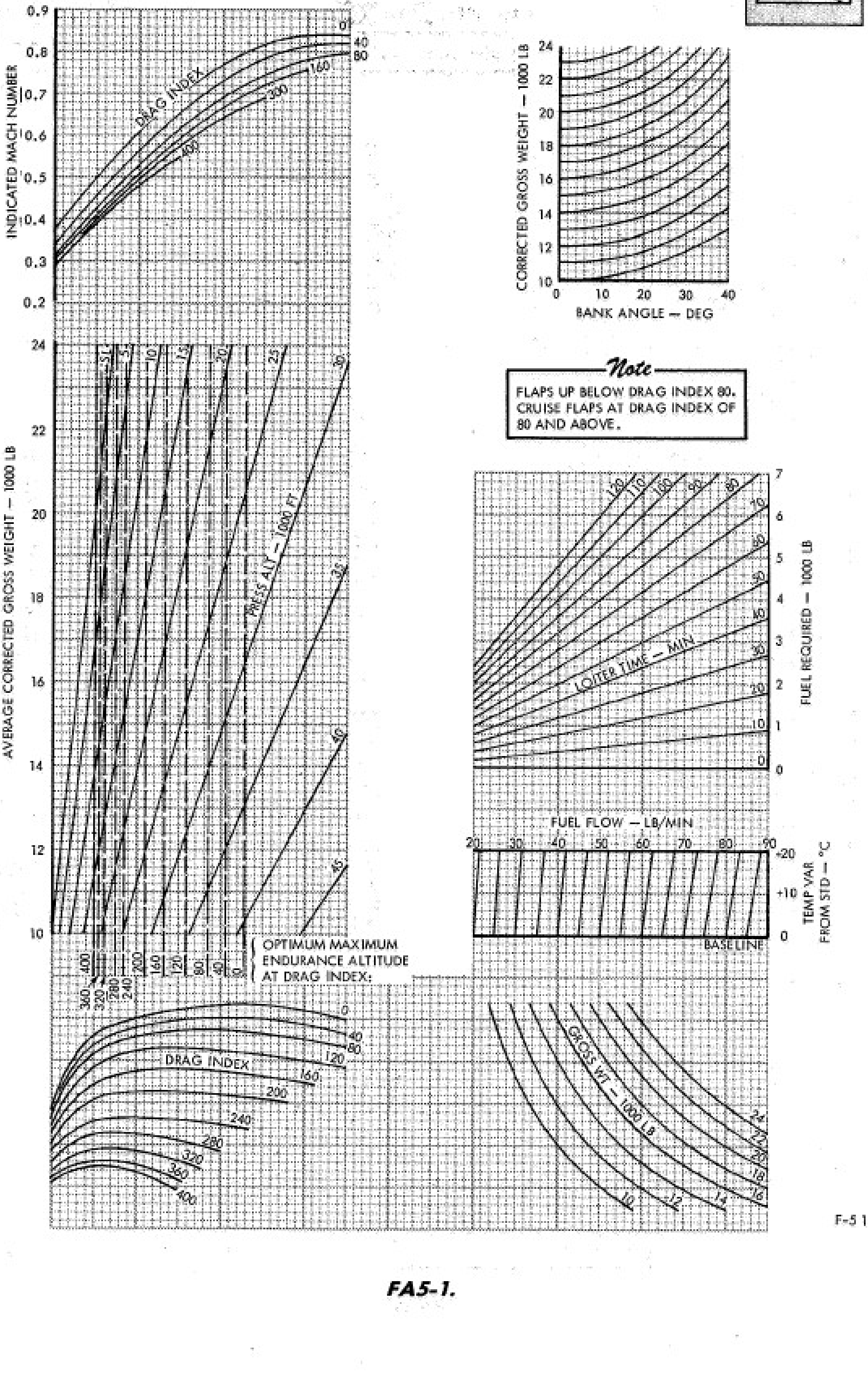
MODEL: F-5E/F
DATE: 1 DECEMBER 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

MAXIMUM ENDURANCE

TIME, FUEL, MACH NUMBER, AND OPTIMUM ALTITUDE

DRAG INDEX 0 TO 400



F-5 1-517(20)A

FA5-1.

MODEL: F-5E/F
DATE: 1 DECEMBER 1976
DATA BASIS: **FLIGHT TEST**

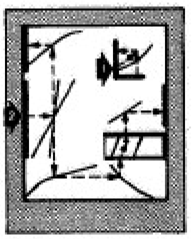
ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

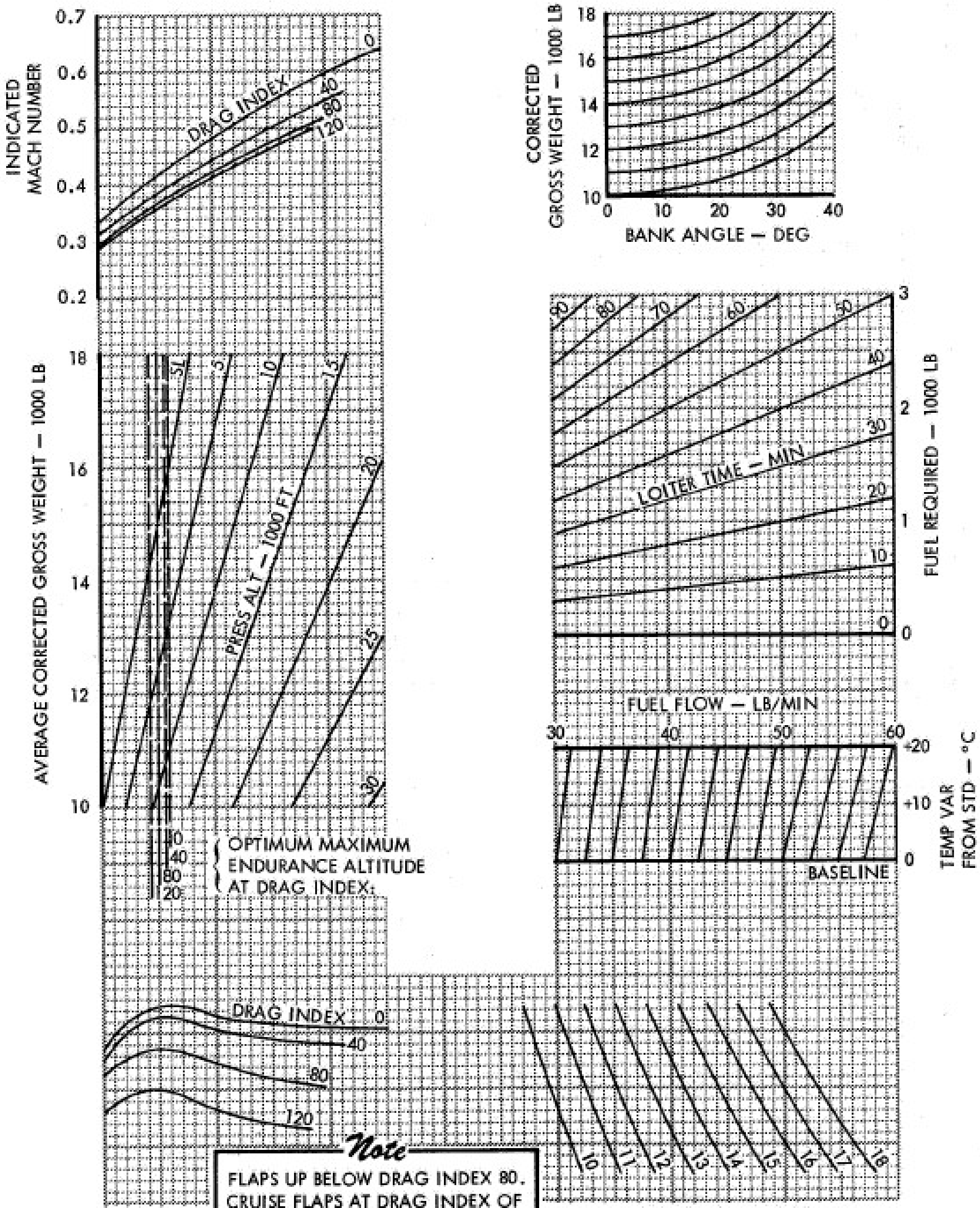
MAXIMUM ENDURANCE

TIME, FUEL, MACH NUMBER, AND OPTIMUM ALTITUDE

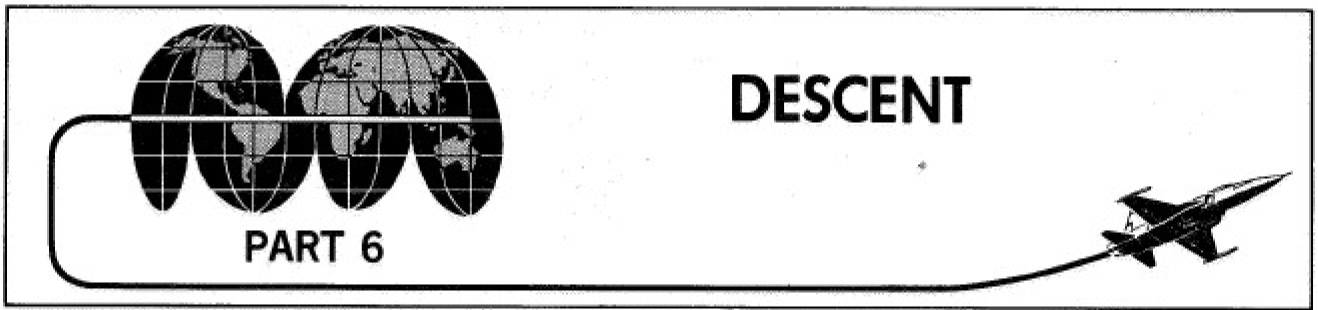
DRAG INDEX 0 TO 120

SINGLE ENGINE





FA5-2.



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MAXIMUM RANGE DESCENT CHART

The maximum range descent chart in FA6-1 determines fuel, time, and distance required to descend from altitude at idle rpm. These data cover an altitude range from approximately 45,000 feet pressure altitude to sea level at a constant 270 KIAS (Ⓕ 275 KIAS) for drag indexes of 0 thru 400 and for all gross weights. The descent is made with flaps up and with speed brake IN.

USE

Enter chart at initial descent pressure altitude and proceed up to the value of drag index configuration (interpolation required for values between drag index curves on graphs). Read, fuel, time, and distance required for descent at the left of each plotted drag index. To determine fuel, time, and distance required to descend from a higher altitude to a lower altitude, take the difference between the values read at the two altitudes.

PENETRATION DESCENT CHARTS

The Penetration Descent charts provide time, fuel, and distance to descend with the speed brake positioned at 0°, 30°, and 45° in FA6-2 thru FA6-4, respectively. Maximum speed brake extension with a centerline store is 30° [T.O. 1F-5E-541]. Unmodified aircraft are limited to 25° speed brake extension with 275-gallon centerline tank.

USE

Use of the Penetration Descent charts is the same as that for the Maximum Range Descent chart except for the constant penetration speed of 300 KIAS.

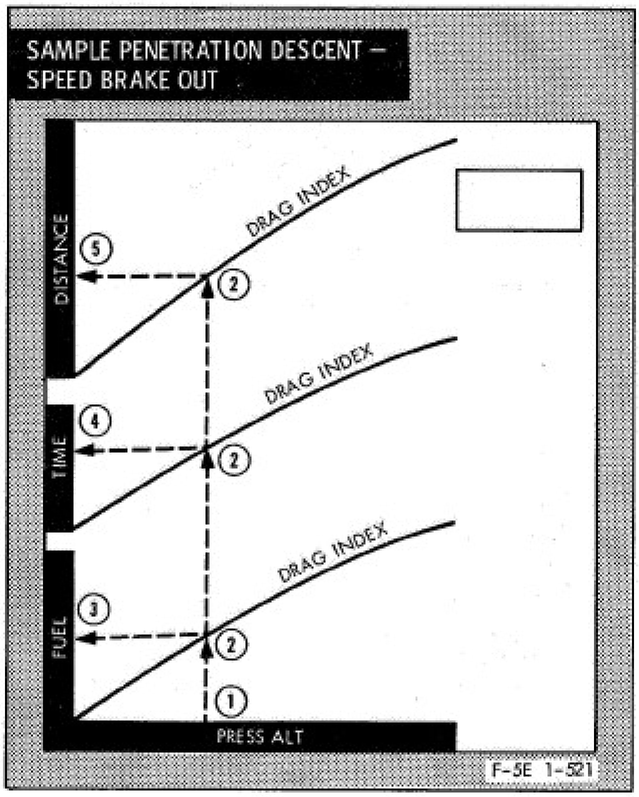
SAMPLE PROBLEM

Given:
A. Configuration drag index: 100.
B. Cruise altitude: 15,000 ft.

Calculate:
A. Fuel, time, and distance required for penetration descent with speed brake at 45°, 300 KIAS, from cruise altitude to sea level.

B. Use Penetration Descent, 80% RPM, chart FA6-4.

①	Press Alt	15,000 ft
②	Drag Index	100
③	Fuel	57 lb
④	Time	2.3 min
⑤	Distance	13.5 nm



MODEL: F-5E/F
DATE: 1 JULY 1975
DATA BASIS: **ESTIMATED**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

MAXIMUM RANGE DESCENT

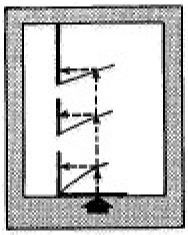
IDLE RPM

SPEED BRAKE IN   FLAPS UP

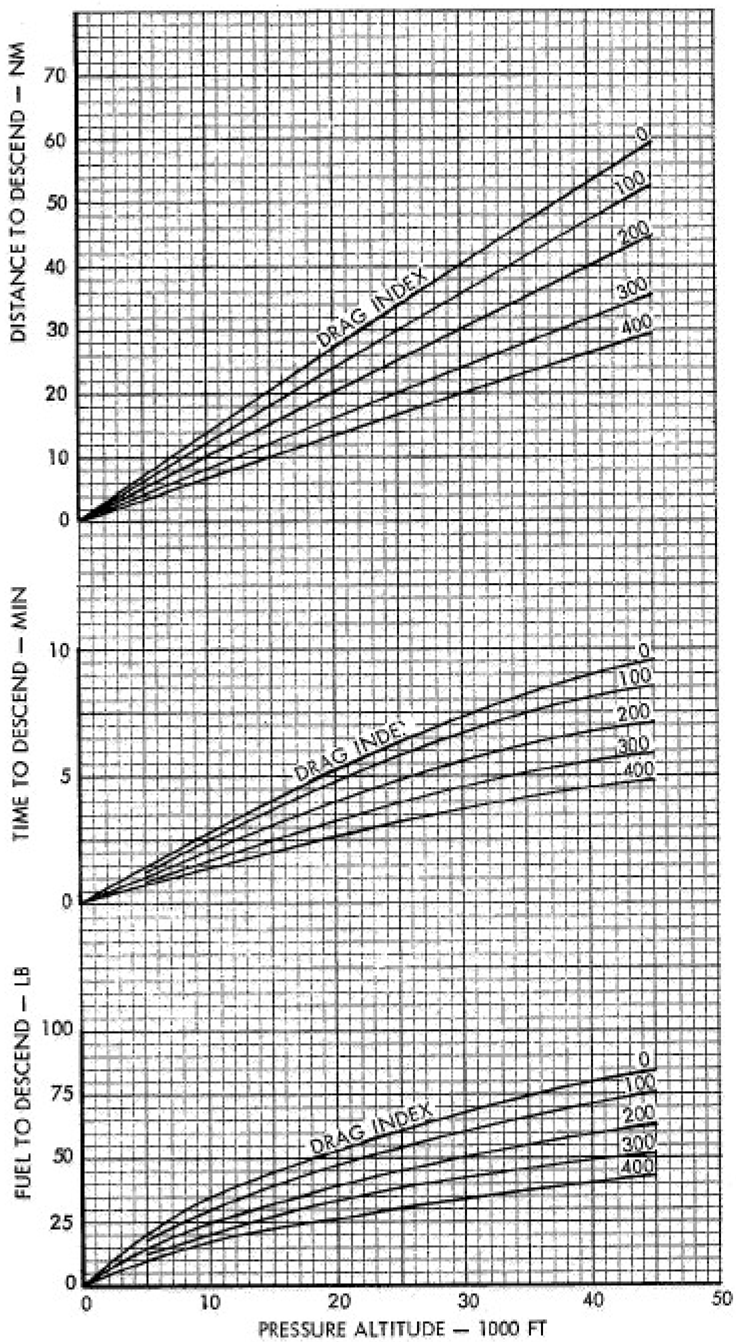
STANDARD DAY

DRAG INDEX 0 TO 400

ALL GROSS WEIGHTS



DESCENT SPEED SCHEDULE
E 270 KIAS
F 275 KIAS



F-5 1-552(20)

FA6-1.

MODEL: F-5E/F
DATE: 1 AUGUST 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

PENETRATION DESCENT

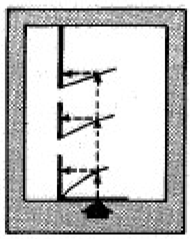
80% RPM

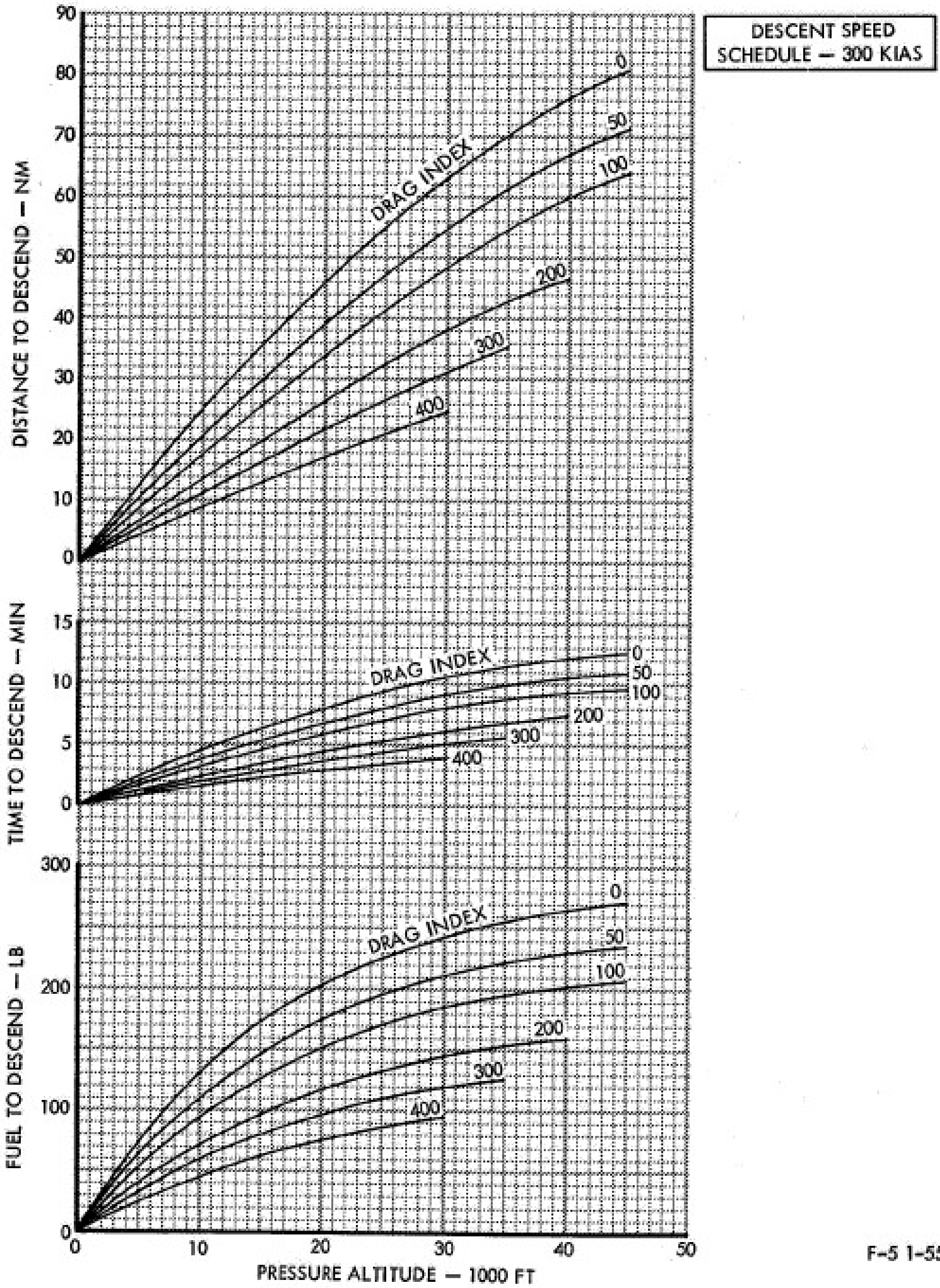
SPEED BRAKE IN   MANEUVERING FLAPS

STANDARD DAY

DRAG INDEX 0 TO 400

ALL GROSS WEIGHTS





F-5 1-553(20)

FA6-2.

MODEL: F-5E/F
DATE: 1 AUGUST 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

PENETRATION DESCENT

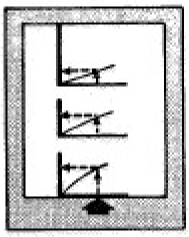
80% RPM

SPEED BRAKE 30° CL TANK MANEUVERING FLAPS

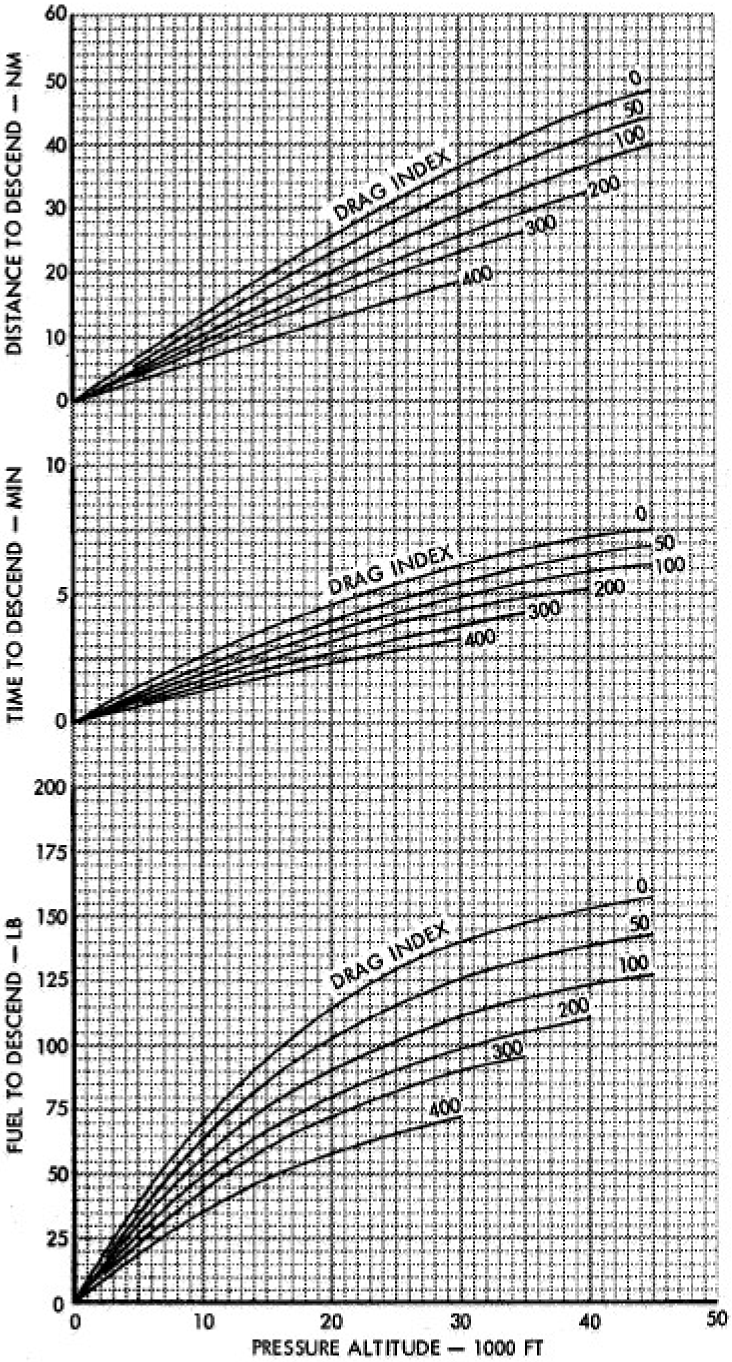
STANDARD DAY

DRAG INDEX 0 TO 400

ALL GROSS WEIGHTS



DESCENT SPEED
SCHEDULE — 300 KIAS



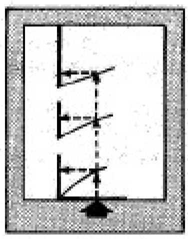
F-5 1-594(20)

FA6-3.

MODEL: F-5E/F
DATE: 1 AUGUST 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

PENETRATION DESCENT

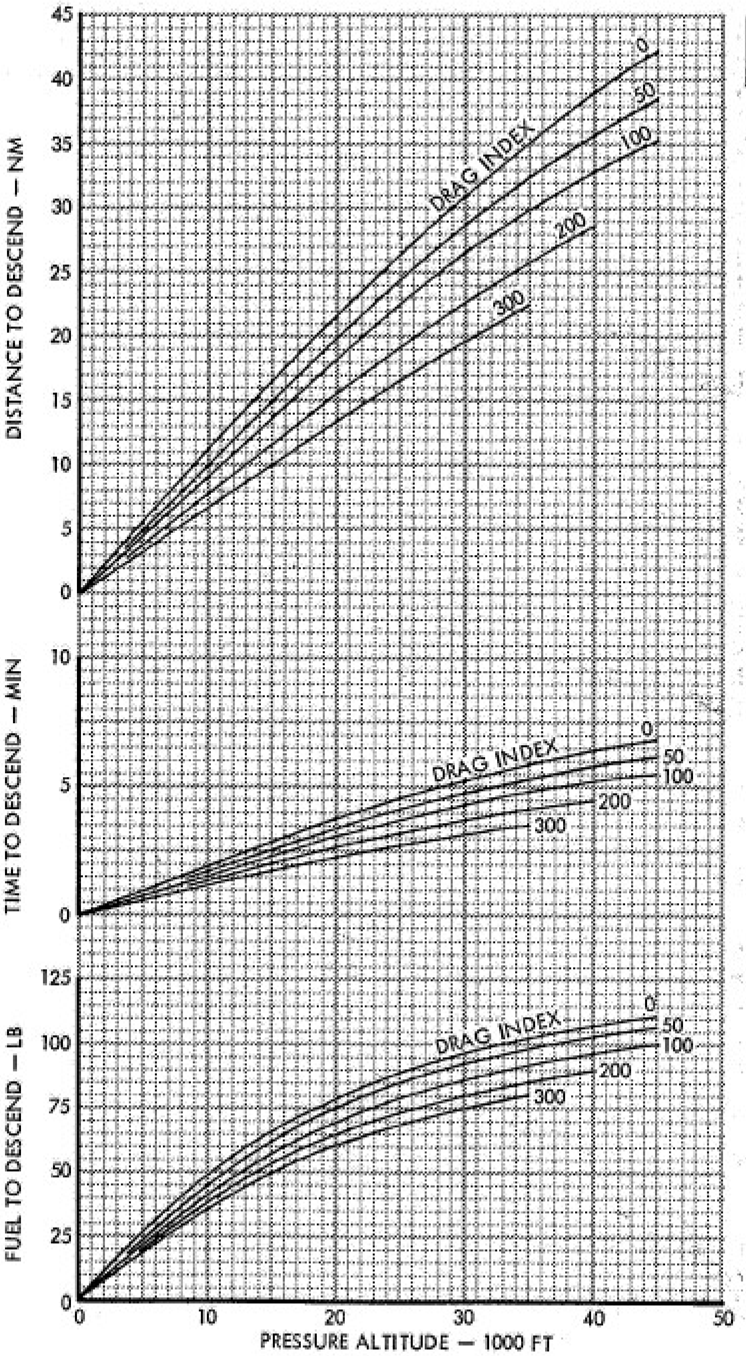


80% RPM

SPEED BRAKE 45° MANEUVERING FLAPS

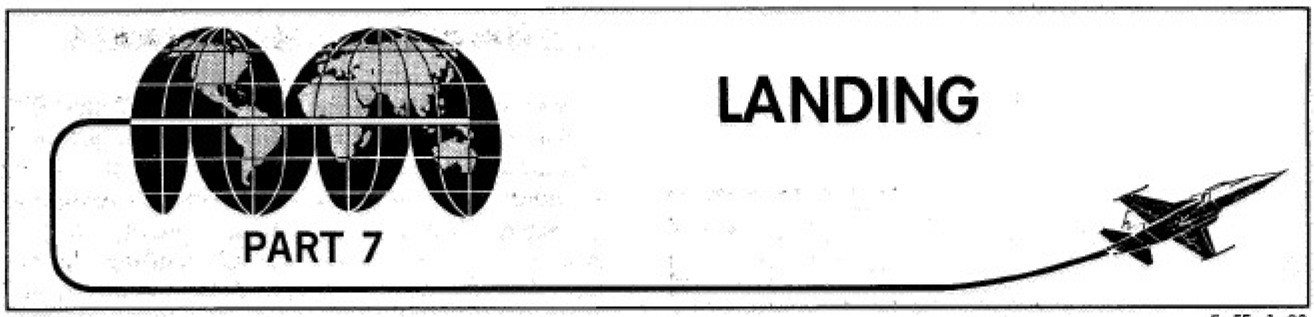
STANDARD DAY
DRAG INDEX 0 TO 300
ALL GROSS WEIGHTS

DESCENT SPEED SCHEDULE — 300 KIAS



F-5 1-554(20)

FA6-4.



PART 7 — LANDING

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Page numbers underlined denote charts.

LANDING CHARTS (GENERAL)

Landing charts determine normal final approach speed, total distance from a 50-foot obstacle, touchdown speed, ground roll distance, and minimum distance from touchdown to hook engagement. The Landing Ground Roll and Total Distance charts are based on a cg position of 15% MAC with provisions to show effect on landing distance of drag chute use. All data is based on full flap configuration.

NOTE

Refer to part 1 of this appendix for Runway Wind Components chart.

LANDING SPEED SCHEDULE CHART

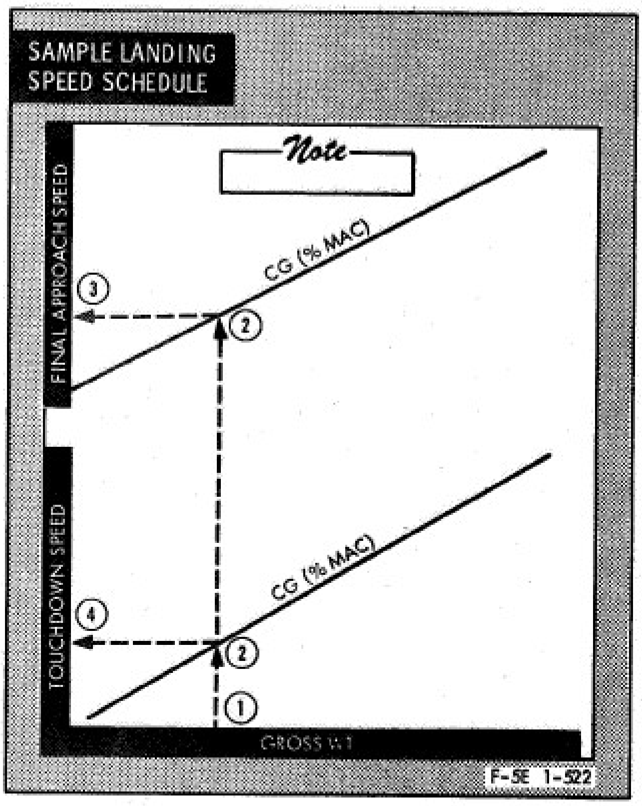
The Landing Speed Schedule chart (FA7-1, sheets 1 and 2) presents final approach and touchdown speeds as a function of gross weight and cg position. The AOA indexer should be used as the primary reference for normal landings. Disregard the indexer for single-engine landings.

USE

Enter FA7-1 with gross weight and proceed vertically up to cg position (% MAC) on touchdown speed and final approach speed scales of the chart. At each point of intersection of the cg curves, proceed horizontally left and read values of final approach and touchdown speeds, respectively.

SAMPLE PROBLEM

Given:
A. Landing gross weight: 12,100 lb.
B. CG position: 19% MAC.



Calculate:
A. Final approach and touchdown speeds.
B. Use Landing Speed Schedule chart FA7-1.

①	Gross Wt	12,100 lb
②	CG	19%
③	Final Approach Speed	147 KIAS
④	Touchdown Speed	137 KIAS

LANDING DISTANCE CHARTS

Two Landing Distance charts (FA7-2 and FA7-3) (without and with drag chute) present ground roll distance and total distance from 50-foot obstacle as a function of gross weight, runway temperature, pressure altitude, and wind velocity for a cg position of 15% MAC. Total landing distance is based on passing over the 50-foot obstacle at final approach speed on a 3-degree flight path angle followed by a landing flare and touchdown at computed touchdown speed with zero rate of sink.

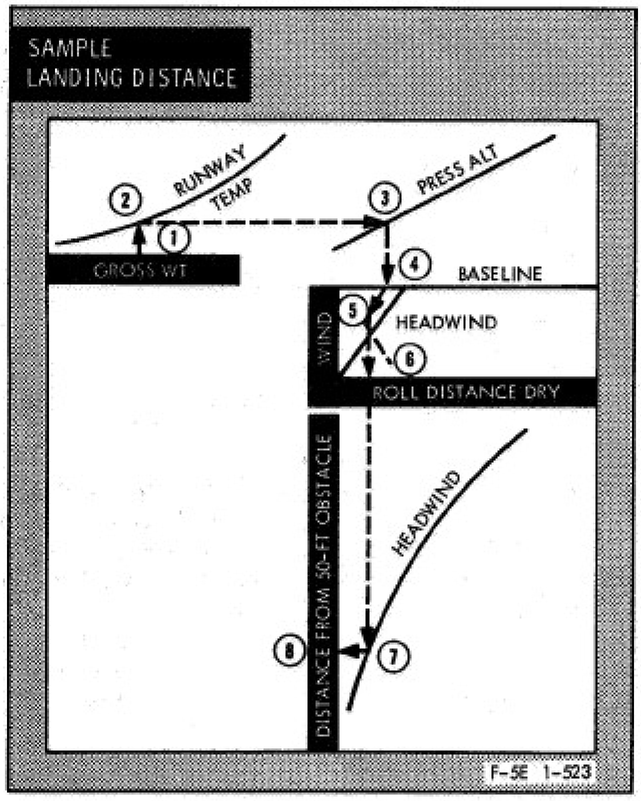
The flare initiation height tends to increase with landing weight. Ground roll distance is based on heavy braking throughout ground roll on a dry, hard-surfaced runway following a 3-second free roll period to allow the nose to fall thru, and another second for brake application. Ground roll distance, using the drag chute and heavy braking is based on deployment of the drag chute up to 180 KIAS. The chute handle is assumed to be pulled at the nosewheel down point, with full deployment following in 2 seconds. Shorter stopping distances can be achieved by use of maximum braking.

USE

Enter appropriate chart with gross weight, proceed up to runway temperature and then right to pressure altitude. From this point proceed downward to the baseline (zero-wind line). Move down contouring the appropriate guideline (headwind or tailwind) to wind velocity, then vertically down and read ground roll distance. Continue down to the zero, headwind, or tailwind velocity curve and then left to read total distance from 50-foot obstacle.

SAMPLE PROBLEM

Given:
A. Landing gross weight: 12,100 lb.
B. Runway temperature: +13°C.
C. Runway pressure altitude: 1000 ft.
D. Headwind: 20 kt.
E. No drag chute.



Calculate:

A. Ground roll distance and total distance from 50-foot obstacle.
B. Use Landing Distance, Full Flaps, CG 15% MAC, No Drag Chute chart FA7-2.

①	Gross Wt	12,100 lb
②	Runway Temp	+13°C
③	Press Alt	1000 ft
④	Baseline	——
⑤	Headwind	20 kt
⑥	Ground Roll Distance	2750 ft
⑦	Headwind	20 kt
⑧	Total Distance (from 50-ft obstacle)	4200 ft

EFFECT OF RUNWAY CONDITIONS (RCR) ON GROUND ROLL DISTANCE CHARTS

The Effect of Runway Conditions (RCR) on Ground Roll Distance charts for use without and with drag chute are presented in FA7-4 and FA7-5, respectively. The charts correct the landing ground roll distance for changes in braking efficiency caused by variations in runway surface conditions. An RCR of 23 represents heavy braking action on a dry, hard-surfaced runway. An RCR less than 23 represents a decrease in braking efficiency.

USE

Enter appropriate chart with ground roll distance for dry, hard-surfaced runway and proceed vertically upward to RCR number. Then proceed horizontally left to read corrected ground roll distance.

SAMPLE PROBLEM

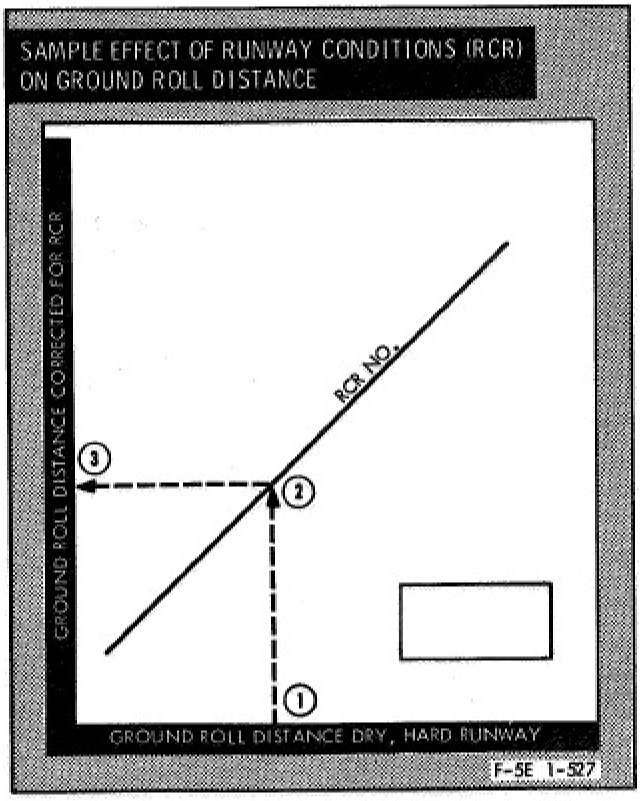
Given:

A. Ground Roll Distance (dry, hard-surfaced runway): 2750 ft.
B. RCR: 12
C. No drag chute.

Calculate:

A. Ground roll distance corrected for RCR.
B. Use Effect of Runway Conditions (RCR) on Ground Roll Distance chart FA7-4.

①	Ground Roll Distance	2750 ft
②	RCR	12
③	Ground Roll Distance Corrected for RCR	4300 ft



ARRESTING HOOK ENGAGEMENT CHARTS (GENERAL)

The arresting hook engagement speeds are based on a maximum hook load limit of 57,000 pounds. The distance required to decelerate from the normal touchdown speed to the hook limit speed is shown for hook engagement speeds of 160 knots and 125 knots. The 160-knot engagement speed is to be used with the BAK-9 and BAK-12 arresting barrier and the 125-knot engagement speed is to be used with any authorized arresting barrier. These distances are based on normal landing speeds and techniques.

MINIMUM DISTANCE FROM TOUCHDOWN TO HOOK ENGAGEMENT CHARTS

The Distance from Touchdown to Hook Engagement charts for 160-knot and 125-knot engagement speeds (FA7-6 and FA7-7) present the required minimum distance to lower the nosewheel to the runway, apply brakes, and decelerate from the recommended landing speed at touchdown to the recommended hook engagement speed for a cg position of 15% MAC. This distance is a function of runway temperature pressure altitude, and gross weight. Corrections are provided in the chart for headwind or tailwind and RCR.

USE

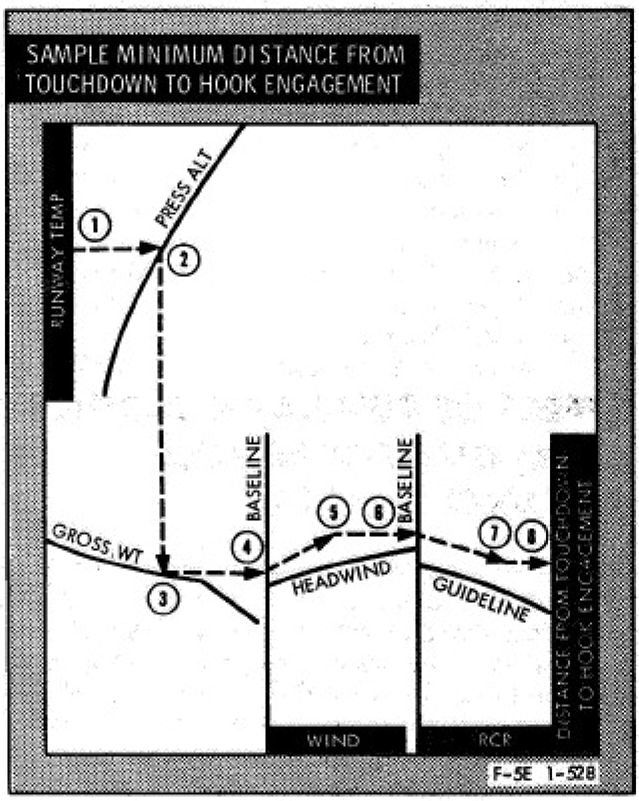
Enter appropriate chart with runway temperature and proceed right to pressure altitude. From this point, proceed down to the landing gross weight, then right to the wind correction baseline. Contour the guidelines for either headwind or tailwind to the wind velocity (if no wind, proceed directly thru). From this point proceed right to the RCR correction baseline. Contour the guidelines, as appropriate, to the RCR value for the runway condition (if runway is dry, hard-surfaced proceed directly thru) and proceed right to read distance from touchdown to hook engagement.

SAMPLE PROBLEM

Given:
A. Runway temperature: +15°C.
B. Runway pressure altitude: 1000 ft.
C. Gross weight: 13,000 lb.
D. Headwind: 20 kt.
E. RCR: 12.
F. Hook engagement speed: 125 kt.

Calculate:
A. Distance from touchdown to hook engagement.
B. Use Minimum Distance from Touchdown to Hook Engagement, 125-knot Hook Engagement Speed, No Drag Chute, CG 15% MAC chart FA7-7.

①	Runway Temp	+15°C
②	Press Alt	1000 ft
③	Gross Wt	13,000 lb
④	Baseline	———
⑤	Headwind	20 kt
⑥	Baseline	———
⑦	RCR	12
⑧	Distance from Touchdown to Hook Engagement (cg 15%)	650 ft



MODEL: F-5E
DATE: 1 MARCH 1976
DATA BASIS: **FLIGHT TEST**

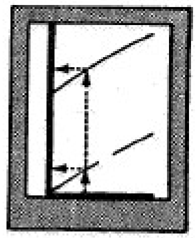
ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

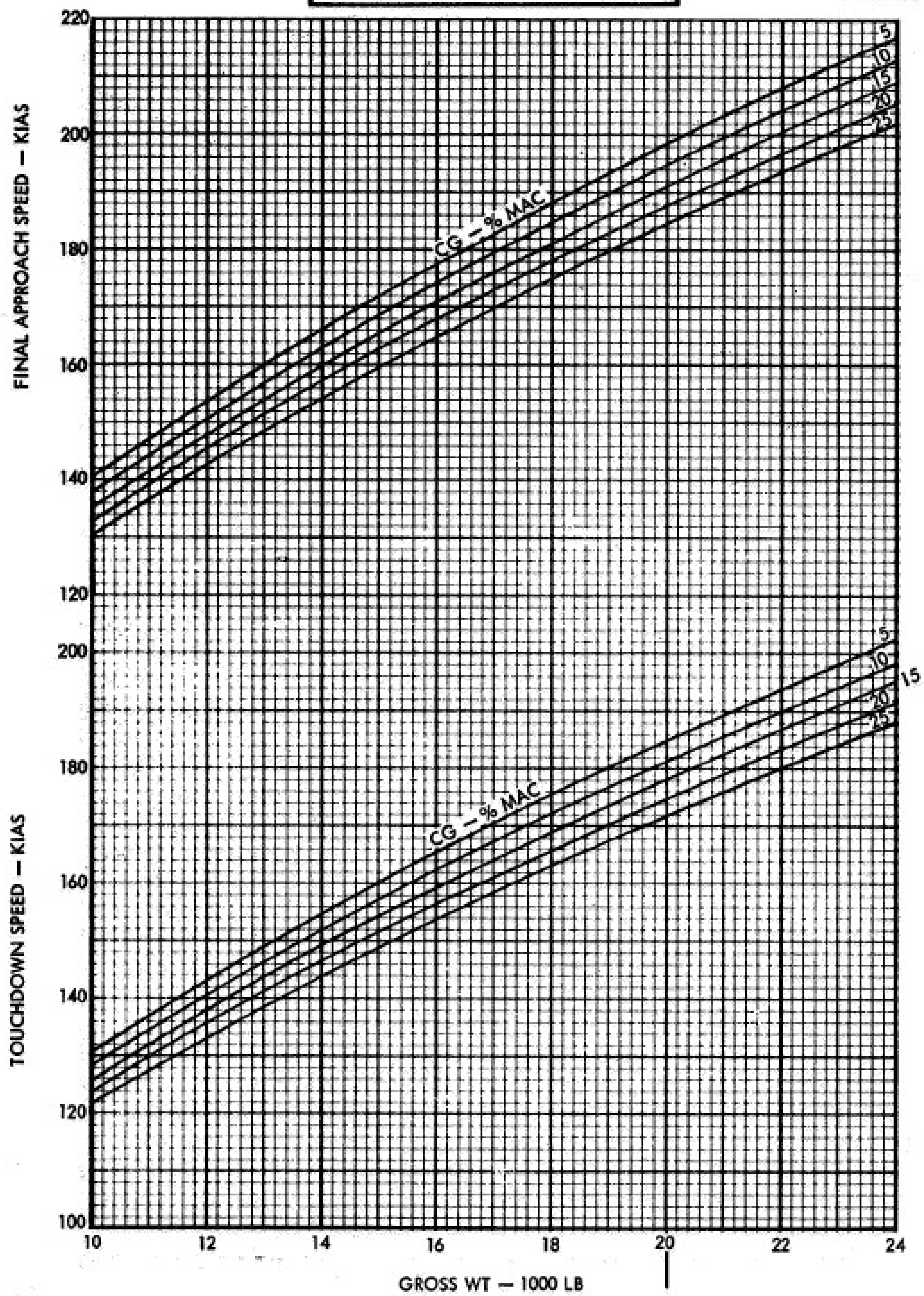
LANDING SPEED SCHEDULE

FULL FLAPS

Note

THRESHOLD SPEED (50-FOOT OBSTACLE) IS EQUAL TO FINAL APPROACH SPEED.





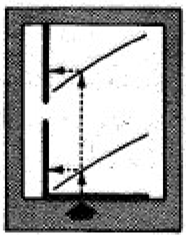
FA7-1 (Sheet 1).

MODEL: F-5F
DATE: 1 AUGUST 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

LANDING SPEED SCHEDULE

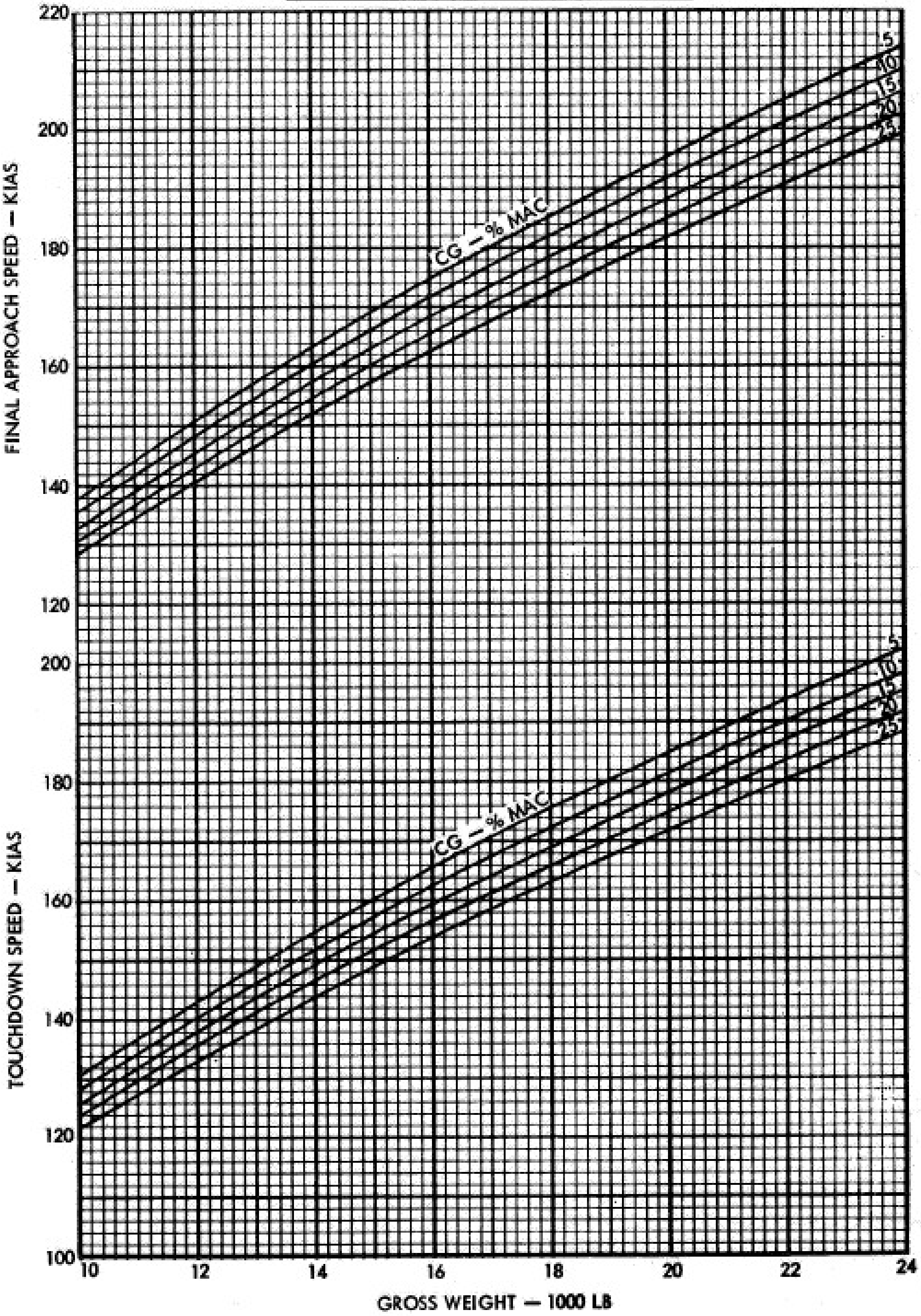
FULL FLAPS



F

Note

THRESHOLD SPEED (50-FOOT OBSTACLE) IS EQUAL TO FINAL APPROACH SPEED.



F-5 1-502(21)

FA7-1 (Sheet 2).

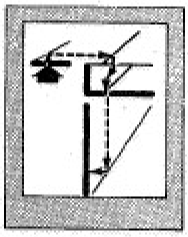
MODEL: F-5E/F
DATE: 1 AUGUST 1976
DATA BASIS: **FLIGHT TEST**

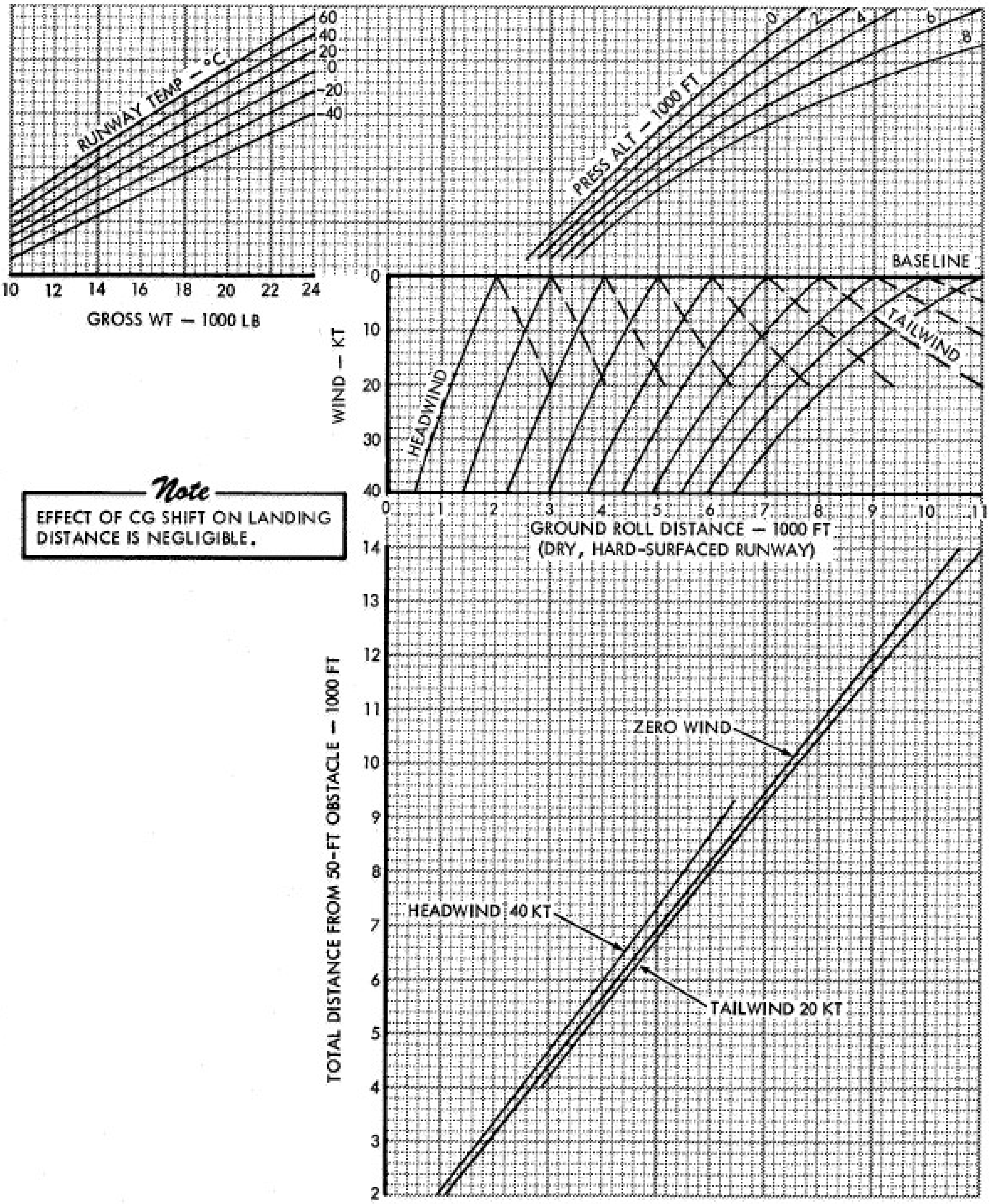
ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

LANDING DISTANCE

FULL FLAPS
CG 15% MAC

NO DRAG CHUTE





Note

EFFECT OF CG SHIFT ON LANDING DISTANCE IS NEGLIGIBLE.

F-5 1-500(20)

FA7-2.

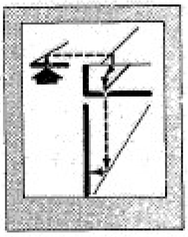
MODEL: F-5E/F
DATE: 1 AUGUST 1976
DATA BASIS: **FLIGHT TEST**

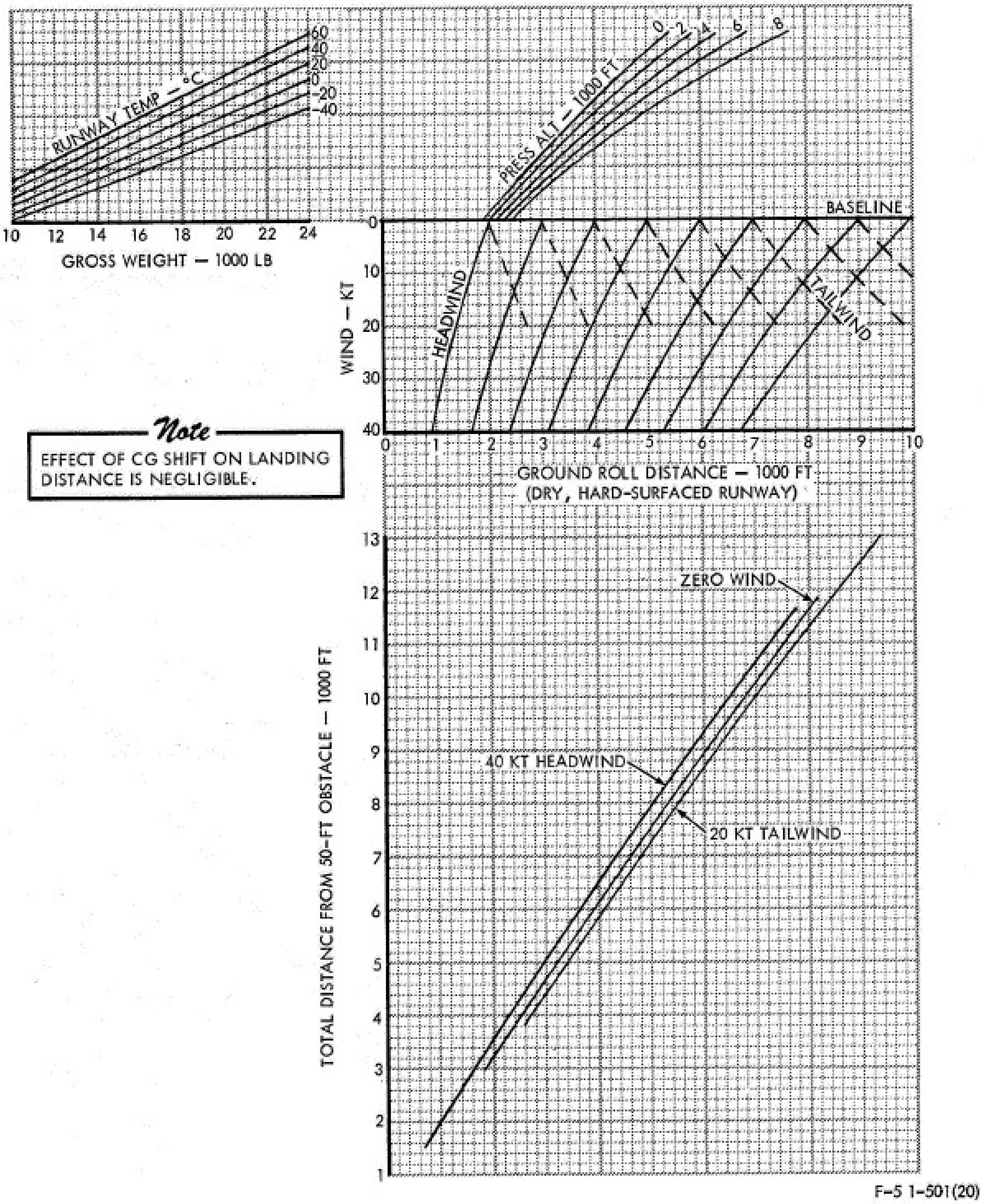
ENGINES: (2)J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

LANDING DISTANCE

FULL FLAPS
CG 15% MAC

WITH DRAG CHUTE





Note

EFFECT OF CG SHIFT ON LANDING DISTANCE IS NEGLIGIBLE.

FA7-3.

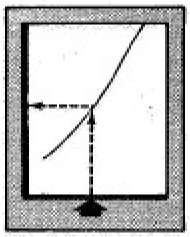
MODEL: F-5E/F
DATE: 1 AUGUST 1976
DATA BASIS: **FLIGHT TEST**

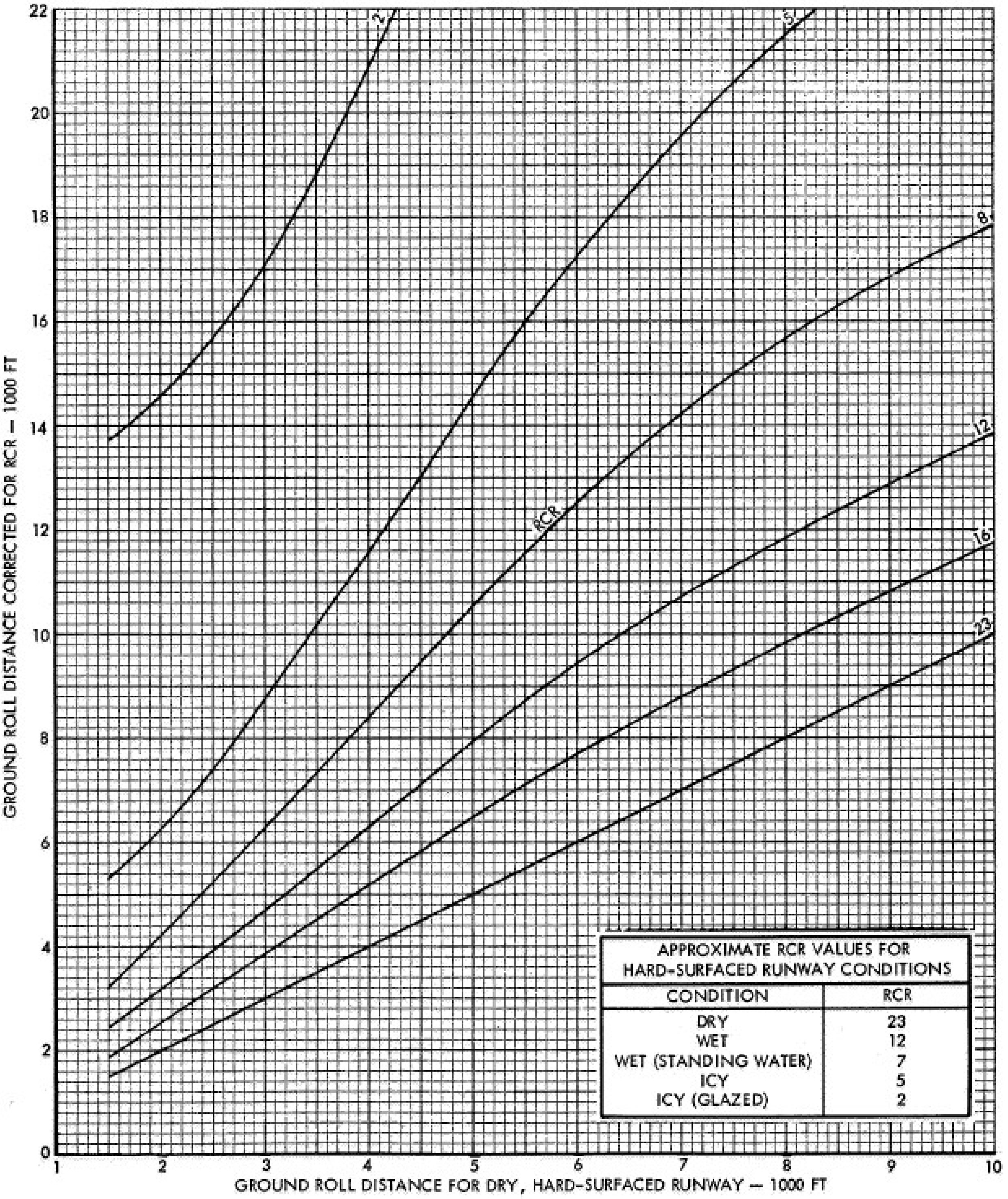
ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

EFFECT OF RUNWAY CONDITIONS (RCR) ON GROUND ROLL DISTANCE

FULL FLAPS

NO DRAG CHUTE





APPROXIMATE RCR VALUES FOR HARD-SURFACED RUNWAY CONDITIONS

CONDITION	RCR
DRY	23
WET	12
WET (STANDING WATER)	7
ICY	5
ICY (GLAZED)	2

FA7-4.

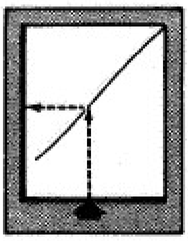
MODEL: F-5E/F
DATE: 1 AUGUST 1976
DATA BASIS: **FLIGHT TEST**

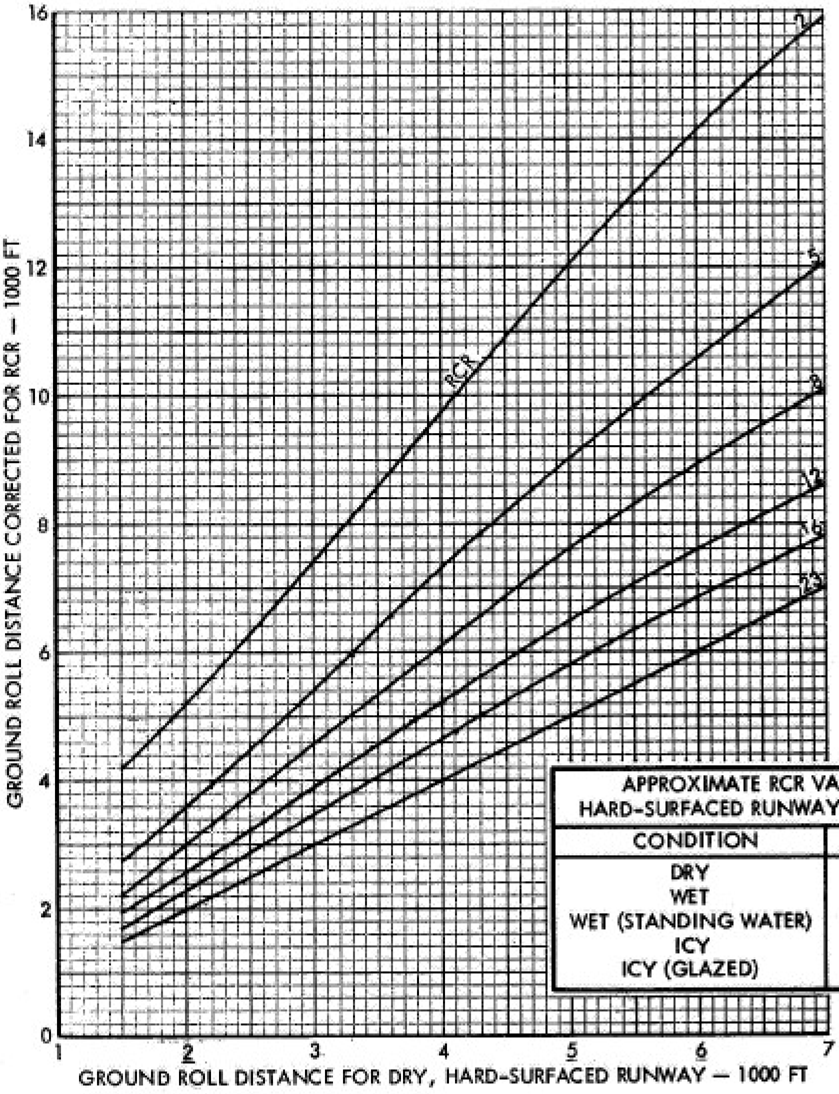
ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

EFFECT OF RUNWAY CONDITIONS (RCR) ON GROUND ROLL DISTANCE

FULL FLAPS

WITH DRAG CHUTE





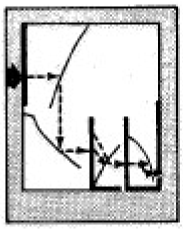
APPROXIMATE RCR VALUES FOR HARD-SURFACED RUNWAY CONDITIONS	
CONDITION	RCR
DRY	23
WET	12
WET (STANDING WATER)	7
ICY	5
ICY (GLAZED)	2

F-5 1-561(20)

FA7-5.

MODEL: F-5E/F
DATE: 1 AUGUST 1977
DATA BASIS: **FLIGHT TEST**
ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

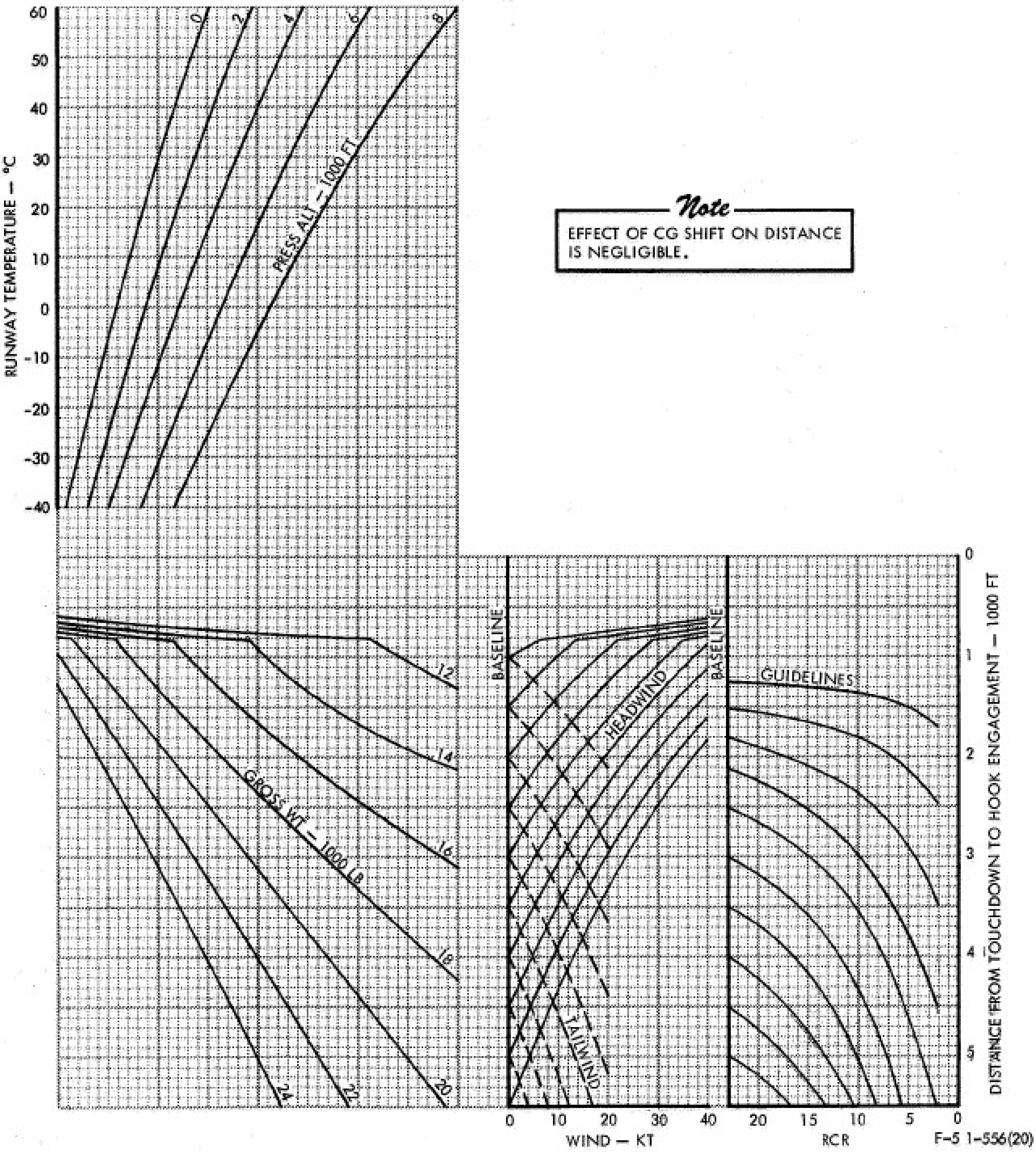
MINIMUM DISTANCE FROM TOUCHDOWN TO HOOK ENGAGEMENT (BASED ON RECOMMENDED TOUCHDOWN SPEED)



160-KNOT HOOK ENGAGEMENT SPEED

NO DRAG CHUTE

CG = 15% MAC



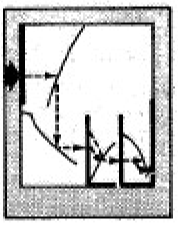
Note

EFFECT OF CG SHIFT ON DISTANCE IS NEGLIGIBLE.

FA7-6.

MODEL: F-5E/F
DATE: 1 AUGUST 1977
DATA BASIS: **FLIGHT TEST**
ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

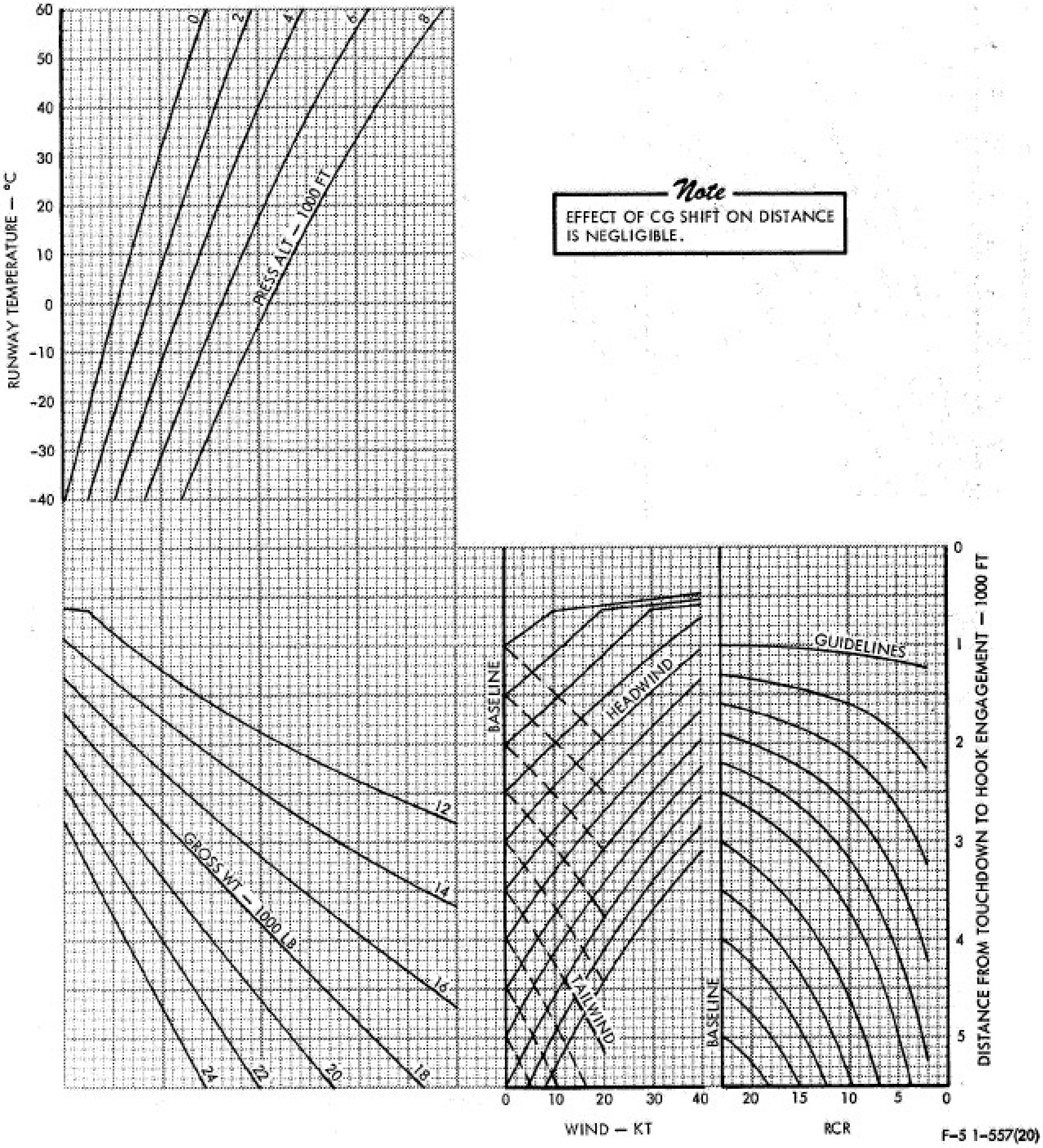
MINIMUM DISTANCE FROM TOUCHDOWN TO HOOK ENGAGEMENT (BASED ON RECOMMENDED TOUCHDOWN SPEED)



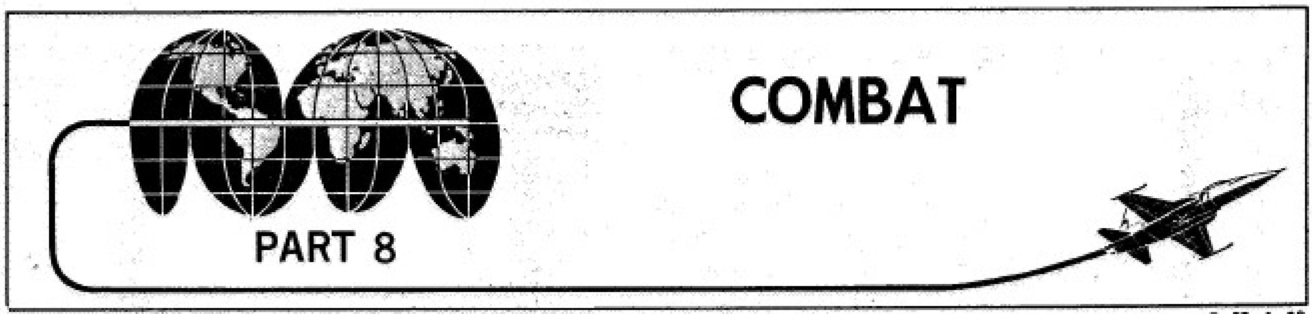
125-KNOT HOOK ENGAGEMENT SPEED

NO DRAG CHUTE

CG = 15% MAC



FA7-7.



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Page numbers underlined denote charts.

COMBAT PERFORMANCE CHARTS (GENERAL)

The combat performance charts provide data for use during maneuvering flight at low altitude, high altitude, supersonic climb, and level flight with maximum and military thrust and the use of maneuvering flap. Turn performance data are presented for accelerating, decelerating, and steady state conditions.

COMBAT FUEL ALLOWANCE CHART

The Combat Fuel Allowance chart (FA8-1) for maximum or military thrust determines total fuel flow for two engines in pounds per minute as a function of pressure altitude and mach number.

USE

Enter appropriate thrust chart with pressure altitude and proceed right to indicated mach number. Move down and read fuel flow in pounds per minute.

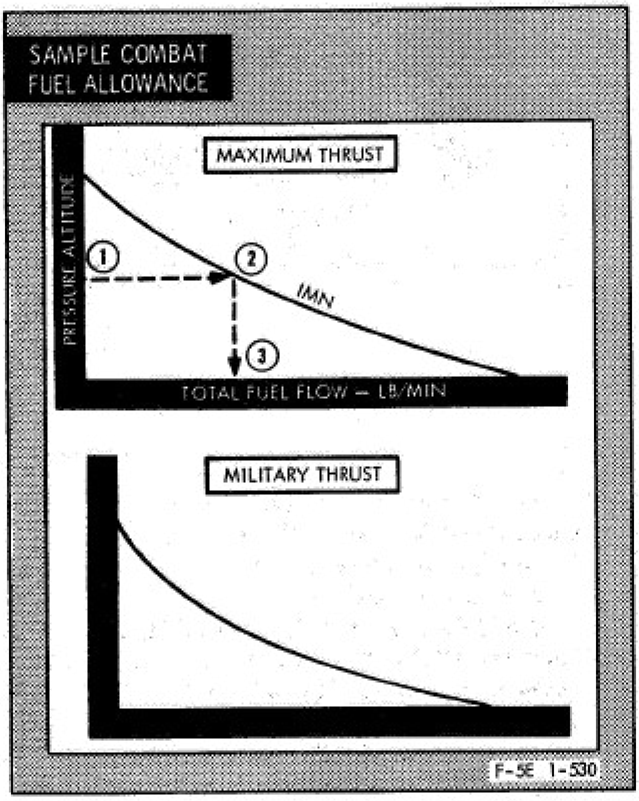
SAMPLE PROBLEM

Given:
A. Pressure altitude: 26,000 ft.
B. Airspeed: 1.2 IMN.
C. Maximum thrust.
D. Combat duration: 3 min.

Calculate:
A. Fuel flow and fuel used during combat.
B. Use Combat Fuel Allowance, Maximum Thrust, chart FA8-1.

①	Press Alt	26,000 ft
②	Airspeed	1.2 IMN
③	Fuel Flow	290 lb/min

C. Fuel Flow (290 lb/min) X Time (3 min) = Total Fuel Used.
Thus: 290 lb/min X 3 min = 870 lb.



LEVEL FLIGHT ACCELERATION AT LOW ALTITUDE CHARTS

Level Flight Acceleration at Low Altitude for maximum and military thrust is shown in FA8-2 and FA8-3. The time, distance, and fuel required to accelerate from 0.5 IMN is presented as a function of drag index, initial gross weight, final desired indicated mach number, and ambient temperature. Maximum thrust covers a drag index range of 0 thru 440. Military thrust covers the range of 0 thru 200 because of the low acceleration obtained at high drag index numbers.

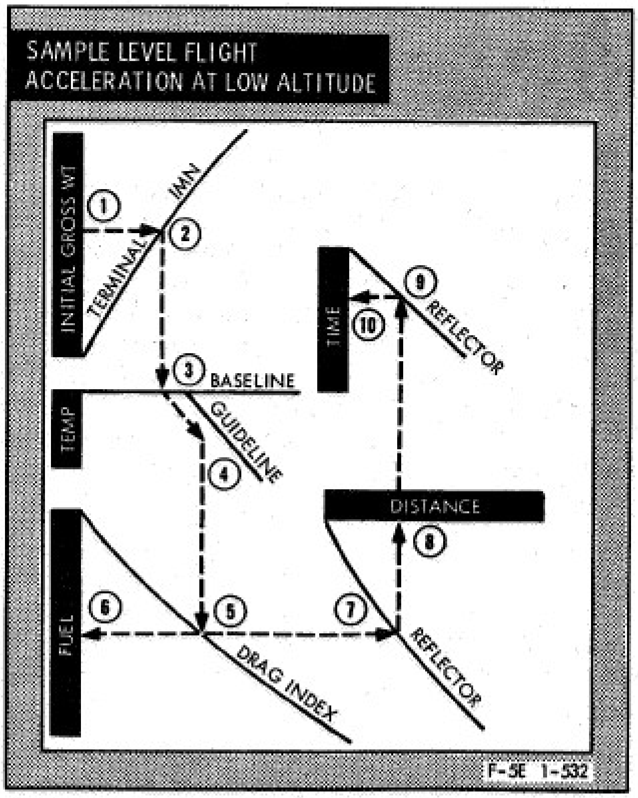
USE

Enter appropriate chart with initial gross weight (operating weight) and proceed right to terminal (desired) indicated mach number. From this point proceed down to the baseline (standard temperature) of the temperature portion of the chart and then parallel the guidelines for hotter (if necessary) temperature to the temperature in degrees above standard.

From this point, again proceed down to the drag index curve and left to read fuel required. Return to the drag index point of intersection and proceed right to the distance guideline and then up, noting the distance, to the time guideline. At this point move left and read time in minutes.

SAMPLE PROBLEM

Given:
A. Pressure altitude: 3000 ft.
B. Maximum thrust.
C. Accelerate from 0.5 IMN to 0.85 IMN.
D. Initial gross weight: 14,800 lb.
E. Temperature: 10°C hotter-than-standard.
F. Drag index: 85.



Calculate:
A. Fuel, distance, and time.
B. Use Level Flight Acceleration at Low Altitude, Maximum Thrust, Initial Mach 0.5, Drag Index 0 to 440 chart, FA8-2.

①	Initial Gross Wt	14,800 lb
②	Terminal IMN	0.85
③	Baseline (std temp)	———
④	Temp	10°C (hotter)
⑤	Drag Index	85
⑥	Fuel	245 lb
⑦	Reflector	———
⑧	Distance	4 nm
⑨	Reflector	———
⑩	Time	0.6 min

LEVEL FLIGHT ACCELERATION AT 36,000 FEET (HIGH ALTITUDE) CHARTS

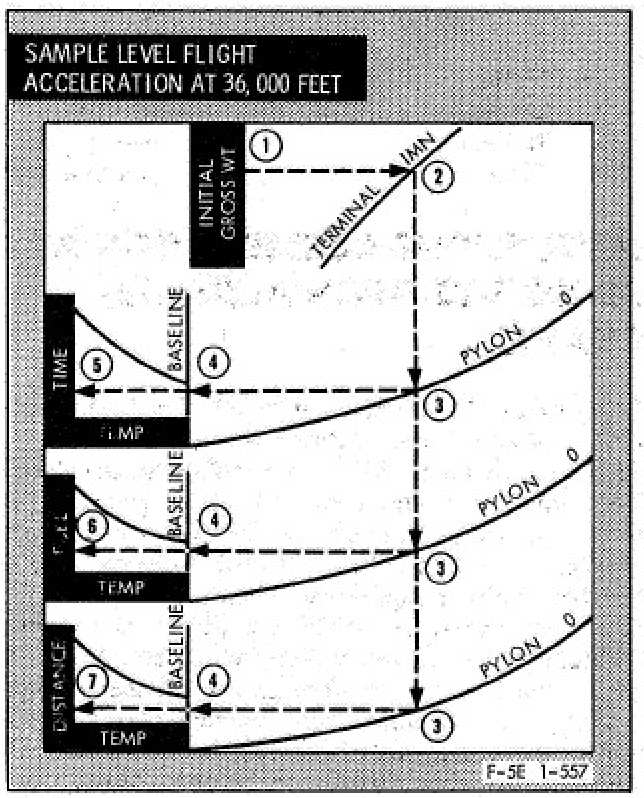
Level Flight Acceleration at 36,000 feet is shown in FA8-4, sheets 1 and 2, thru FA8-7, sheets 1 and 2. The time, distance, and fuel required to accelerate from an initial speed of 0.8 mach number are presented as a function of initial gross weight (operating weight), final desired indicated mach number, and temperature. Data is shown for maximum thrust at 36,000 feet with two wingtip configurations and two wingtip with centerline 275-gallon fuel tank configurations. Dashed lines crossing the constant mach number lines in the upper (initial weight) portion of the charts indicate approximately the maximum speed (M_{Max} less 0.02) to which the aircraft with various numbers of pylons can accelerate in a reasonable length of time.

USE

Enter appropriate chart with initial gross weight and proceed right to terminal (final) mach number and then project downward completely thru the time, fuel, and distance portions of the chart. At each point of intersection of the curves representing proper pylon configuration, proceed left to the baseline of each temperature scale (standard temperature). If temperature is standard, proceed horizontally across; if not, contour the guideline for temperature variation to the temperature in degrees above or below standard. Continue left to read: time — min, fuel — lb, and distance — nm, respectively.

SAMPLE PROBLEM

Given:
A. Pressure altitude: 36,000 ft.
B. Maximum thrust.
C. Accelerate from 0.8 IMN to 1.4 IMN.
D. (2) AIM-9 missiles, (0) pylons.
E. Initial gross weight: 14,200 lb.
F. Temperature (at altitude): Std.



Calculate:
A. Time, fuel, and distance required.
B. Use Level Flight Acceleration at 36,000 Feet chart FA8-5, sheet 1.

①	Initial Gross Wt.	14,200 lb
②	Terminal IMN	1.4
③	Pylon	0
④	Baseline	———
⑤	Time	3 min
⑥	Fuel	610 lb
⑦	Distance	34 nm

SUPERSONIC ZOOM CLIMB CHART

The Supersonic Zoom Climb chart, FA8-8 sheets 1 and 2, in conjunction with the Level Flight Acceleration at 36,000 Feet chart, is the most efficient means of attaining supersonic flight at 45,000 feet. By accelerating to 1.4/1.5 IMN at 36,000 feet and making a zoom (decelerating) climb to 45,000 feet, time, fuel, and distance are saved as compared to:

1. Climbing subsonically to 45,000 feet and accelerating at altitude, or;
2. Accelerating to the target mach (1.2) at 36,000 feet and climbing at 1.2.

Two options, 1.4 IMN and 1.5 IMN start climb speed profiles, are available for gross weights between 12,000 and 15,000 pounds for a wingtip missiles configuration only.

Zoom climb at maximum thrust is performed by pulling the aircraft up at a steady 1.2 G until a climb angle of about 30 degrees is reached. This angle is held until the airspeed decreases to approximately 200 KIAS, then a pushover is made to maintain adequate airspeed margin over the top. If 1.5 G is pulled during the zoom, the aircraft will achieve altitude in less time but at a slightly reduced mach number.

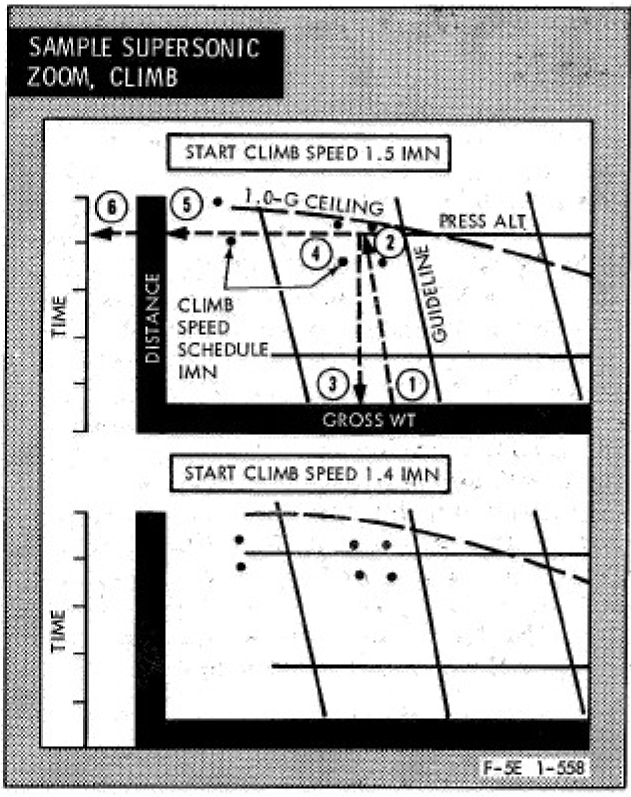
USE

Enter the chart with gross weight and proceed up, following the weight guidelines, to the desired pressure altitude. From this point proceed left to read the supersonic mach number (at the nearest dot, interpolate as required between dots), distance, and time. The higher start climb speeds provide the means to reach the desired altitude at a higher mach number, or to reach the same mach number at a higher altitude. The 1.0-G ceiling line on the chart is the highest altitude at which level flight can be maintained.

Fuel required to climb can be read by proceeding vertically down from the intersection of the pressure altitude to the gross weight scale. This plot represents end climb gross weight; thus, the difference is calculated by subracting the end climb gross weight from the start climb gross weight.

SAMPLE PROBLEM

Given:
A. Start climb gross weight: 13,500 lb.
B. Start climb airspeed: 1.5 IMN.
C. Desired pressure altitude: 45,000 ft.



Calculate:

A. Mach number at 45,000 ft and the fuel, distance, and time required to zoom climb from 36,089 ft to 45,000 ft.

B. Use Supersonic Zoom Climb Chart FA8-8, sheet 1. Enter upper chart for start climb airspeed of 1.5 IMN.

① Start Climb Gross Wt	13,500 lb
② Press Alt	45,000 ft
③ End Climb Gross Wt	13,330 lb

C. To obtain fuel required for climb:
Start Climb Gross Wt — End Climb Gross Wt = Fuel Required.
Thus: 13,500 lb — 13,330 lb = 170 lb

D. Continue profile.

④ IMN (at altitude)	1.25
⑤ Distance	12 nm
⑥ Time	53 seconds

LEVEL FLIGHT COMBAT SPEED CHARTS

Level flight (1.0G) combat speeds are presented in two separate charts (FA8-9, sheets 1 and 2, and FA8-10, sheets 1 and 2), with maneuvering flaps and nonmaneuvering flaps, for a launcher rails only configuration. The speed envelopes are shown as a function of pressure altitude versus mach number based on an aircraft gross weight of 13,300 pounds. The chart utilizing maneuvering flaps shows the region where each flap position is operating, the airspeed at which the flaps automatically shift position, the flap limit speed for the particular position, and the level flight combat ceiling with maximum or military thrust power. The flaps-up chart shows the flight envelope with flaps-up flight and includes supersonic region for standard and nonstandard day temperatures.

USE

The charts may be used for determining a variety of data such as: pressure altitude versus mach, power required, flap positions shift and limit speeds, level flight combat ceilings, and minimum flying speeds.

Maneuvering Flaps

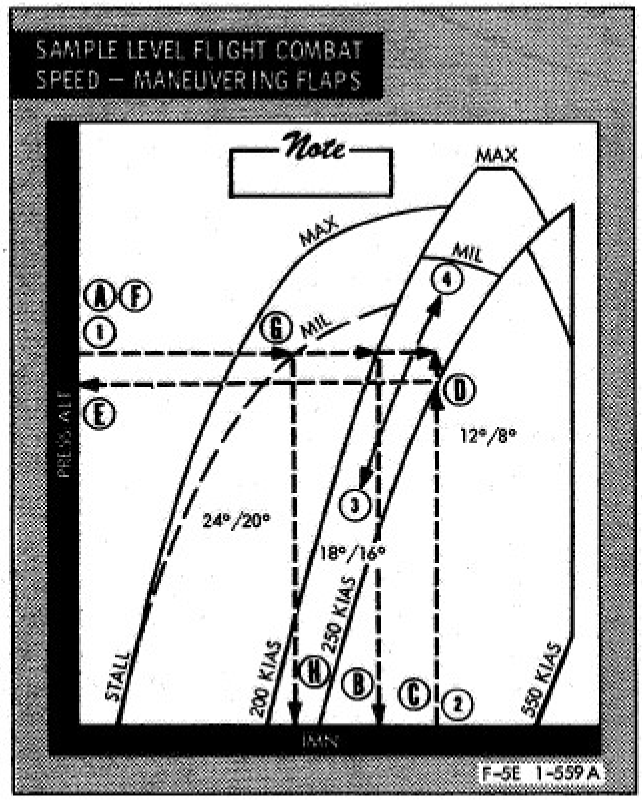
1. Enter with desired pressure altitude and proceed right while simultaneously entering with mach and proceeding up until intersection is made with the pressure altitude. Note the region of intersection and determine flap position and power required.
2. To determine flap autoshift mach number, enter with desired altitude and proceed right to the desired flap position autoshift speed curve and down to read mach number.
3. To determine flap autoshift pressure altitude enter with desired mach number and proceed up to the desired thrust power setting and left to read ceiling.
4. To determine minimum flying speed enter with desired pressure altitude and proceed right to the appropriate thrust power setting and down to read mach number.

Nonmaneuvering Flaps

The use of the nonmaneuvering flap chart is the same as for the maneuvering flap chart with the exception of the higher mach envelopes; which are depicted for standard and nonstandard day temperatures.

SAMPLE PROBLEM

Given:
A. Aircraft with launcher rails only; gross weight: 13,300 lb.
B. Maneuver flaps.
C. Pressure altitude: 30,000 ft.
D. Airspeed: 0.6 IMN.



Calculate:
A. Flap position and thrust power required.
B. Use Level Flight Combat Speed, Maneuvering Flaps Chart FA8-9, sheet 1.

①	Press Alt	30,000 ft
②	IMN	0.6
③	Flap Position	18°/16°
④	Power Required	MIL

C. Flap autoshift speed.

Ⓐ	Press Alt	30,000 ft
Ⓑ	Flap autoshift from 24°/20° to 18°/16°	0.542 IMN

D. Flap autoshift altitude for 18°/16°.

Ⓒ	IMN	0.6
Ⓓ	Intersect	———
Ⓔ	Press Alt (autoshift 18°/16°)	24,500 ft

E. Minimum Safe Flying Speed.

Ⓕ	Press Alt	30,000 ft
Ⓖ	Minimum Power Required	MIL
Ⓗ	IMN (minimum)	0.435

TURN PERFORMANCE — RADIUS CHARTS

The Turn Performance — Radius charts for a typical air-to-ground support low-level mission present turn radius versus mach number with half the total quantity of fuel on board. The charts provide the ability to determine lateral obstacle clearance capability or optimum turn capability during weapons delivery phase of the mission. Turn performance at sea level is shown in FA8-11, sheets 1 and 2; at 5000 feet in FA8-12, sheets 1 and 2. The charts show the minimum turn radii obtainable under sustained conditions (level flight, constant speed) at military or maximum thrust and at the transient maximum lift condition for flap settings of: UP, CRUISE, or MANEUVER. At the MANEUVER setting, the flaps are positioned at 24°/20° below a speed of 200 KIAS 18°/16° between 200 KIAS and 250 KIAS, and 12°/8° between 250 KIAS and 550 KIAS (limit).

USE

Enter the chart with indicated mach number and proceed up to the curve representing the maximum lift or thrust condition and flap setting of interest. Then proceed horizontally left and read the radius of turn.

SAMPLE PROBLEM

Given:
A. Configuration of: (2) AIM-9 Missiles, CL Tank, and (4) MK-82 Bombs.
B. Pressure altitude: 5000 Ft.
C. Airspeed: 0.5 IMN.
D. Military thrust (sustained).
E. Flap setting: MANEUVER.

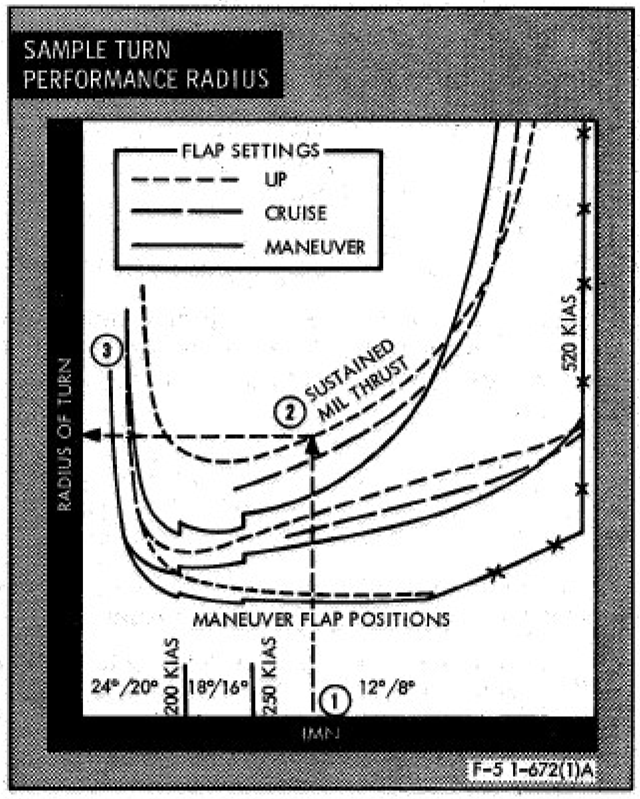
Calculate:
A. Radius of turn required.
B. Use Turn Performance — Radius — 5000 feet chart FA8-12, sheet 1.

①	IMN	0.5
②	Sustained MIL Thrust (MANEUVER flap setting)	———

NOTE

Maneuver flap position is 12°/8°.

③	Radius of Turn	4900 ft



TURN PERFORMANCE — TURN RATE, TURN RADIUS, AND LOAD FACTOR CHARTS

The Turn Performance — Turn Rate, Turn Radius, and Load Factor charts provide for a typical air-to-air combat configuration consisting of two AIM-9 missiles, full 20mm ammunition, and one-half internal fuel at altitudes of 5000 feet (FA8-13, sheets 1 and 2), 15,000 ft (FA8-14, sheets 1 and 2), and 30,000 feet (FA8-15, sheets 1 and 2). In addition to providing best combat turn performance for these altitudes, the charts also indicate the flap position operating regimes wtihin the data envelope.

USE

The charts are of the multi-entry type. An explanation of chart terminology and general use is as follows.

On each chart a line, identified as SUSTAINED, representing sustained flight conditions (level flight, constant speed) shows the maximum turn rate obtainable with maximum thrust as a function of mach number. Additionally, a background "fan" grid, consisting of load factor and turn radius parameters, is shown to provide supplementary information. It can be seen that the speed for maximum turn rate is considerably faster than that for minimum turn radius.

A second line on the chart, identified as MAX LIFT, shows the maximum instantaneous turn performance obtainable by trading off altitude or airspeed to realize the maximum lift capability of the aircraft. This lift capability is limited to 7.33G for this configuration. At maximum lift, at a particular altitude, the airspeed providing the maximum possible instantaneous turn performance is called the "corner" speed. This corner speed is shown on each chart in the upper left area at the intersection of the maximum lift line with the 7.33G limit line.

Any point lying on the SUSTAINED line represents a condition of drag equal to maximum thrust. All of the thrust available is required to turn in level unaccelerated flight at the particular mach number of interest. This is the condition of ZERO P_S or "specific power." Any point below the SUSTAINED line represents a more shallow turn where excess thrust is available for use in either accelerating to a higher mach number at constant altitude or for climbing to a higher altitude at the same mach number. This is called a region of POSITIVE P_S. Any point lying between the SUSTAINED line and the MAX LIFT line (or 7.33G line) represents a turn condition of increased magnitude, where the drag exceeds thrust and negative rate of climb (descent) or a decreasing speed is developed during the turn. This is a region of NEGATIVE P_S.

DEFINITION

SPECIFIC POWER (P_S): Available excess power which can be used to either climb or accelerate to another speed.

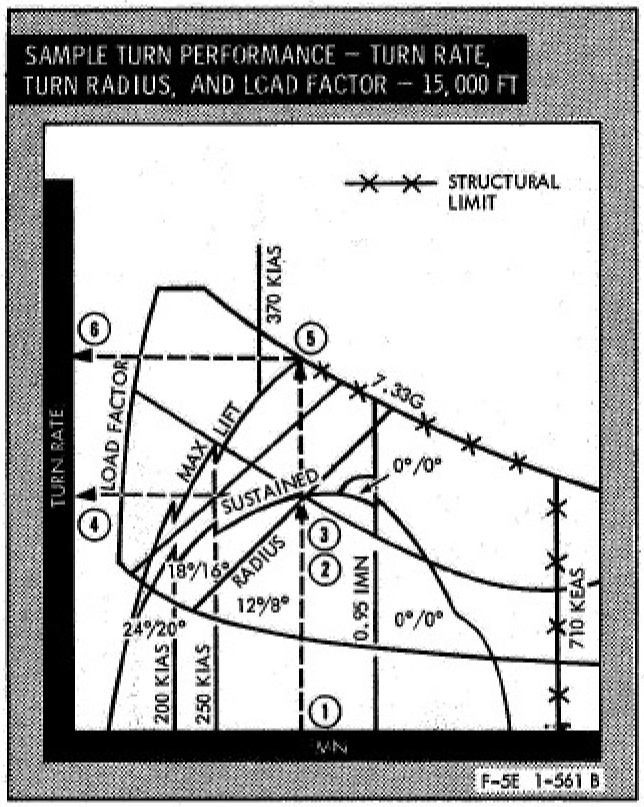
SAMPLE PROBLEM

Given:

A. Aircraft configuration: (2) AIM-9 missiles, full ammo, one-half internal fuel.
B. Maximum thrust.
C. Pressure altitude: 15,000 ft.

Calculate:

A. Final sustained turn rate, turn radius, and load factor at 0.75 mach. In addition, find corresponding values for a 7.33G load factor limit at 0.75 mach.
B. Use Turn Performance Turn Rate, Turn Radius, and Load Factor — 15,000 Feet chart FA8-14, sheet 1.



①	IMN	0.75
②	Sustained Turn Radius	4700 ft
③	Sustained Load Factor	4.3 G
④	Sustained Turn Rate	9.9 deg/sec

C. At 0.75 mach and 7.33G load factor limit:

⑤	Instantaneous Turn Radius	2700 ft
⑥	Instantaneous Turn Rate	17 deg/sec

TURN PERFORMANCE - SPECIFIC EXCESS POWER AND TURN RATE CHARTS

The specific Excess Power (Ps) and Turn Rate charts for an airspeed of 0.6 IMN (FA8-16, sheets 1 and 2) and 0.9 IMN (FA8-17, sheets 1 and 2) allow a study of the effect of trading off available excess thrust (Ps) for a change in speed, rate of climb, or load factor to produce a more desirable flight condition.

USE

The charts are of the multi-entry type. An explanation of the theory and use of the charts is as follows. With any aircraft, a certain amount of thrust is required to maintain level unaccelerated flight. Any excess engine thrust available can be used to increase altitude, speed, or load factor. Specific power, P_S, is a term which defines the available excess power which can be used to either climb or accelerate to another speed. It represents thrust minus drag times speed (giving excess power) divided by weight (giving specific excess power, or power per pound of weight).

Think of it as: $P_S = \dfrac{\text{Thrust-Drag}}{\text{Weight}} \times \text{Speed (fps)}$

in terms of *climb capability*. Now if P_S is divided by speed, a dimensionless term is obtained which represents the longitudinal acceleration in G's. Think of it as:

$$\frac{P_S}{\text{Speed}} = \frac{\text{Thrust-Drag}}{\text{Weight}} = \text{Longitudinal Acceleration (G) in terms of acceleration capability.}$$

In level, 1.0-G (normal acceleration) flight, drag is low and P_S is at its maximum positive value.

During a sustained turn, the aircraft is allowed to bank until drag builds up to match available thrust, and the condition of ZERO P_S is achieved. All of the longitudinal acceleration capability has been traded for normal acceleration capability (load factor) for which a certain turn rate has been obtained.

When maximum available load factor is pulled, drag exceeds thrust and the condition of NEGATIVE P_S is achieved. Here, maximum longitudinal deceleration is obtained, which is desirable when trying to force an adversary on your tail to overshoot. Charts of P_S versus turn rate are shown in FA8-16, sheets 1 and 2, and FA8-17, sheets 1 and 2, for mach number of 0.6 and 0.9, respectively.

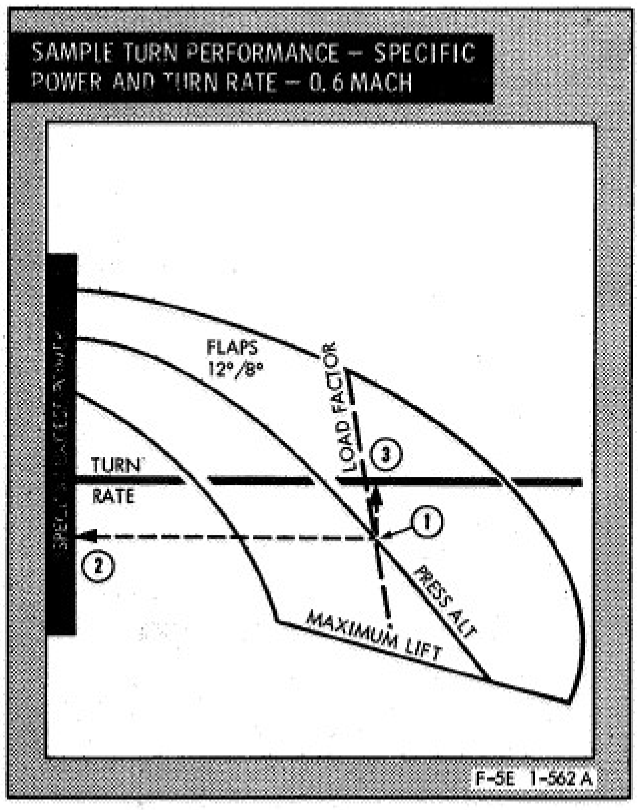
An inspection of FA8-16, sheet 1, for an altitude of 15,000 feet indicates a zero turn rate at 1.0-G load factor at the extreme left of the chart. At this condition, with maximum thrust, a rate of climb of 240 fps (P_S = 240 fps) is available for maneuvering or to perform a level flight acceleration to a higher speed. If a climbing turn is initiated at 0.6 mach, the rate of climb will diminish to 190 fps at 2.0G and to zero at 3.3G (P_S = 0 fps). At zero P_S, the aircraft is in a sustained turn (level flight, constant speed) at 9.1 degrees per second. If the aircraft is forced into a steep turn at 0.6 mach, speed can be maintained as the load factor is increased further until the maximum lift condition is reached at 5.2 G and a turn rate of 14.8 degrees per second. By maintaining the high load factor at this point, the large negative P_S value of –870 fps can be used to create a high deceleration in speed.

It is useful to note that FA8-16 and FA8-17 have data in common with FA8-13 thru FA8-15. For instance, the line for 15,000 feet and 0.6 mach on FA8-16 corresponds to the line for the same conditions on FA8-14. Thus, for the same conditions, P_S values can be obtained from FA8-16 for use with FA8-14.

SAMPLE PROBLEM

Given:

A. Aircraft configuration: (2) AIM-9 missiles, one-half internal fuel.
B. Maximum thrust.
C. Initial mach: 0.6 IMN.
D. Pressure altitude: 15,000 ft.



Calculate:

A. Specific excess power and turn rate with 4.0-G load factor.
B. Use Turn Performance, Specific Power and Turn Rate – 0.6 Mach chart FA8-16, sheet 1.

①	Press Alt and Load Factor	15,000 ft and 4.0G
②	Specific Excess Power	– 225 ft/second
③	Instantaneous Turn Rate	11.2 deg/sec

EFFECT OF PYLONS ON COMBAT PERFORMANCE

The following shows effect of increased drag and gross weight due to the addition of pylons.

MAXIMUM SPEED

At 36,000 feet – 4% loss per pylon.
At 20,000 feet – 3% loss per pylon.
At 5,000 feet – 1 1/2 % per pylon.

NOTE

Ⓔ At 36,000 feet and with 1/2 fuel capacity, the aircraft maximum speed with launcher rails decreases from 1.63 mach without pylons to 1.29 mach with 5 pylons. The addition of missiles on wingtips decreases these speeds to 1.57 mach without pylons and 1.23 with 5 pylons.

NOTE

Ⓕ At 36,000 feet and with 1/2 fuel capacity, the aircraft maximum speed with launcher rails decreases from 1.56 mach without pylons to 1.21 mach with five pylons. The addition of missiles on wingtips decreases these speeds to 1.50 mach without pylons and 1.14 with five pylons.

LEVEL FLIGHT ACCELERATION AT 36,000 FEET

See charts FA8-4 and FA8-5.

SUSTAINED TURN RATE (DEGREES PER SECOND)

A 2% loss per pylon at all altitudes.

TURN RATE AT MAXIMUM LIFT (DEGREES PER SECOND)

A 1% loss per pylon at all altitudes.

SPECIFIC EXCESS POWER AT 0.9 IMN (FEET PER SECOND)

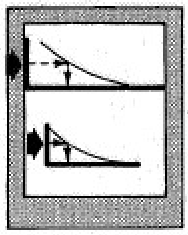
A 4% loss per pylon at all altitudes.

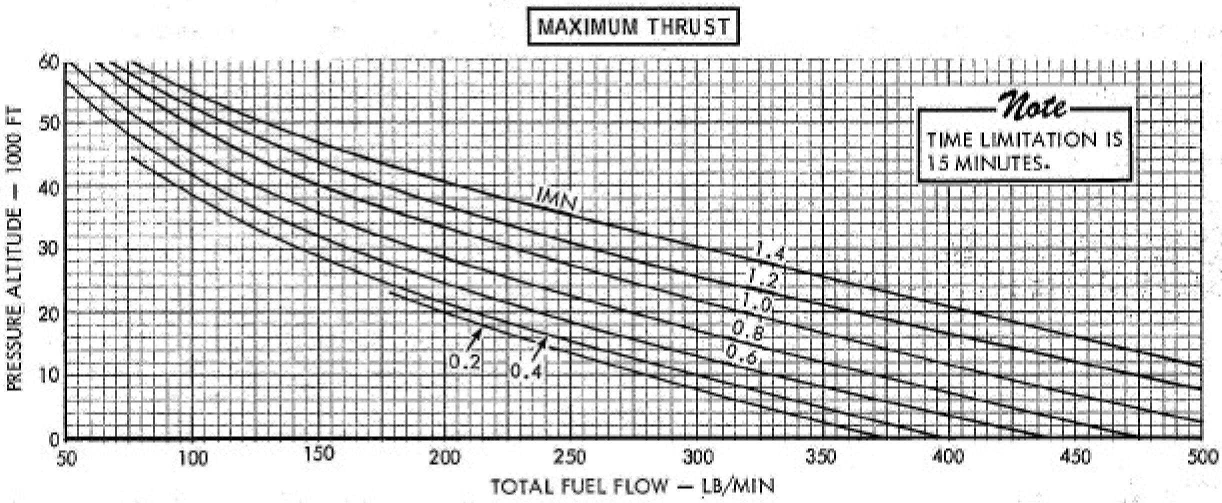
MODEL: F-5E/F
DATE: 1 MARCH 1976
DATA BASIS: **FLIGHT TEST**

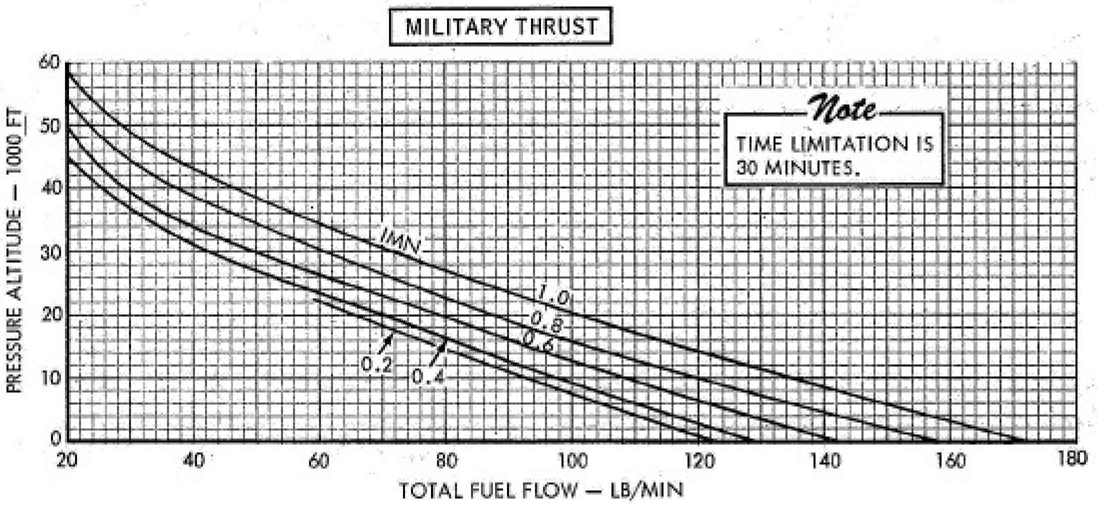
ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

COMBAT FUEL ALLOWANCE

STANDARD DAY







F-5 1-521(20)

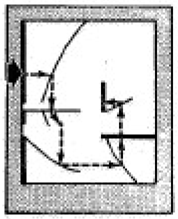
FA8-1.

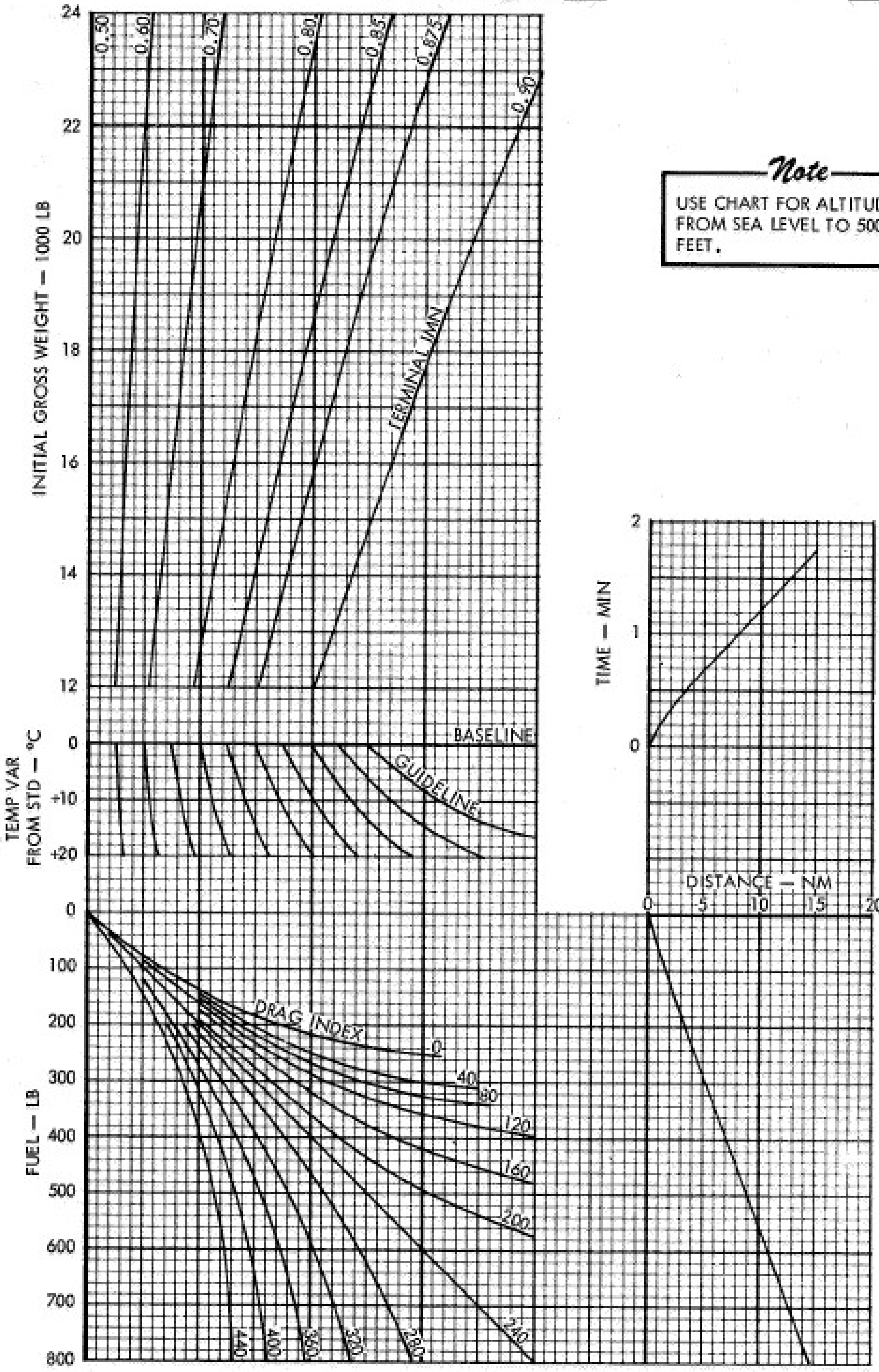
MODEL: F-5E/F
DATE: 1 SEPTEMBER 1973
DATA BASIS: **ESTIMATED**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

LEVEL FLIGHT ACCELERATION AT LOW ALTITUDE (FLAPS UP)

MAXIMUM THRUST
INITIAL MACH 0.5
DRAG INDEX 0 TO 440



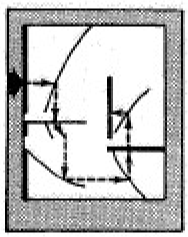


FA8-2.

MODEL: F-5E/F
DATE: 1 AUGUST 1978
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

LEVEL FLIGHT ACCELERATION AT LOW ALTITUDE (FLAPS UP)



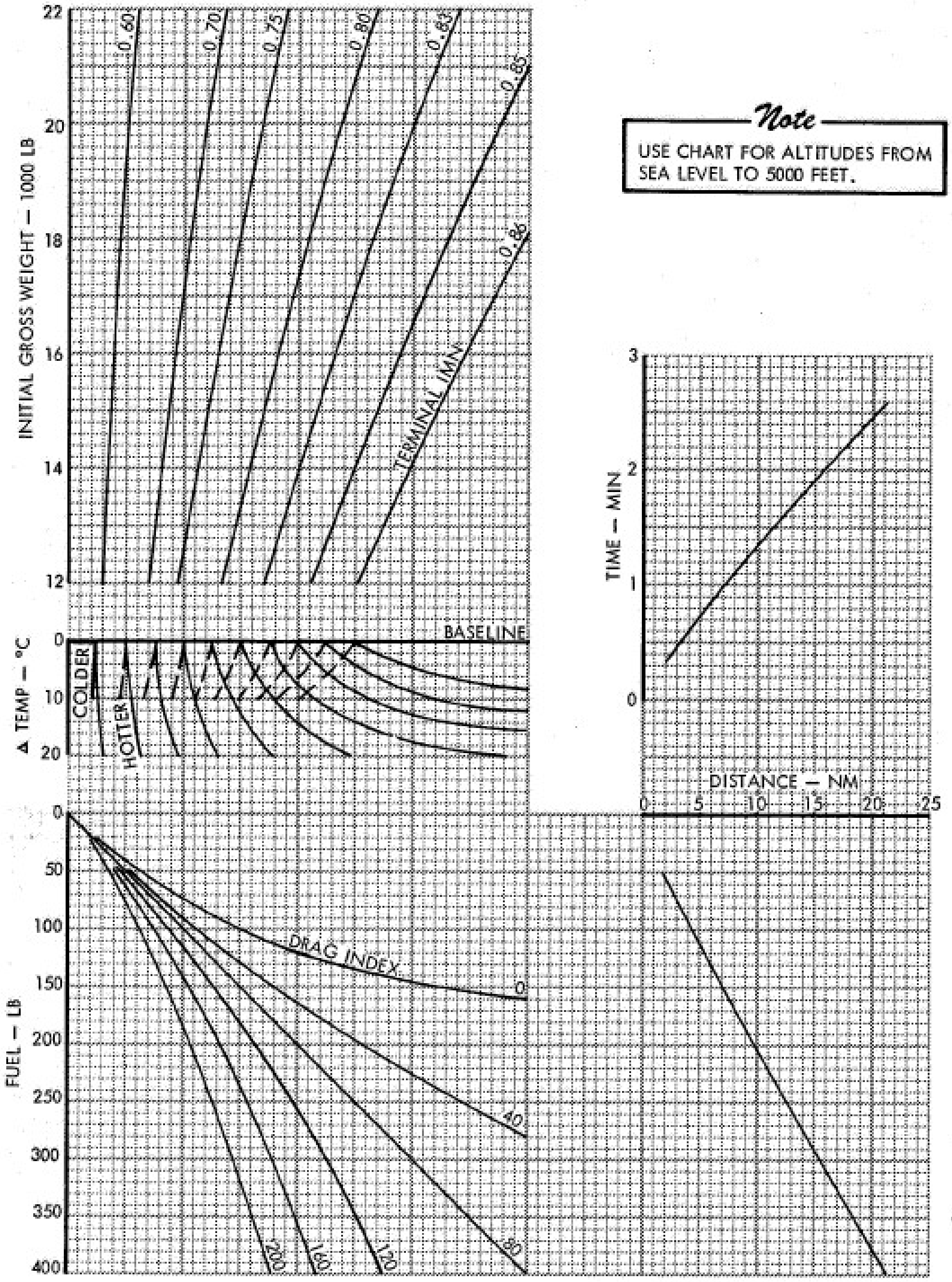
MILITARY THRUST

INITIAL MACH 0.5

DRAG INDEX 0 TO 200

Note

USE CHART FOR ALTITUDES FROM SEA LEVEL TO 5000 FEET.



F-5 1-566(20)A

FA8-3.

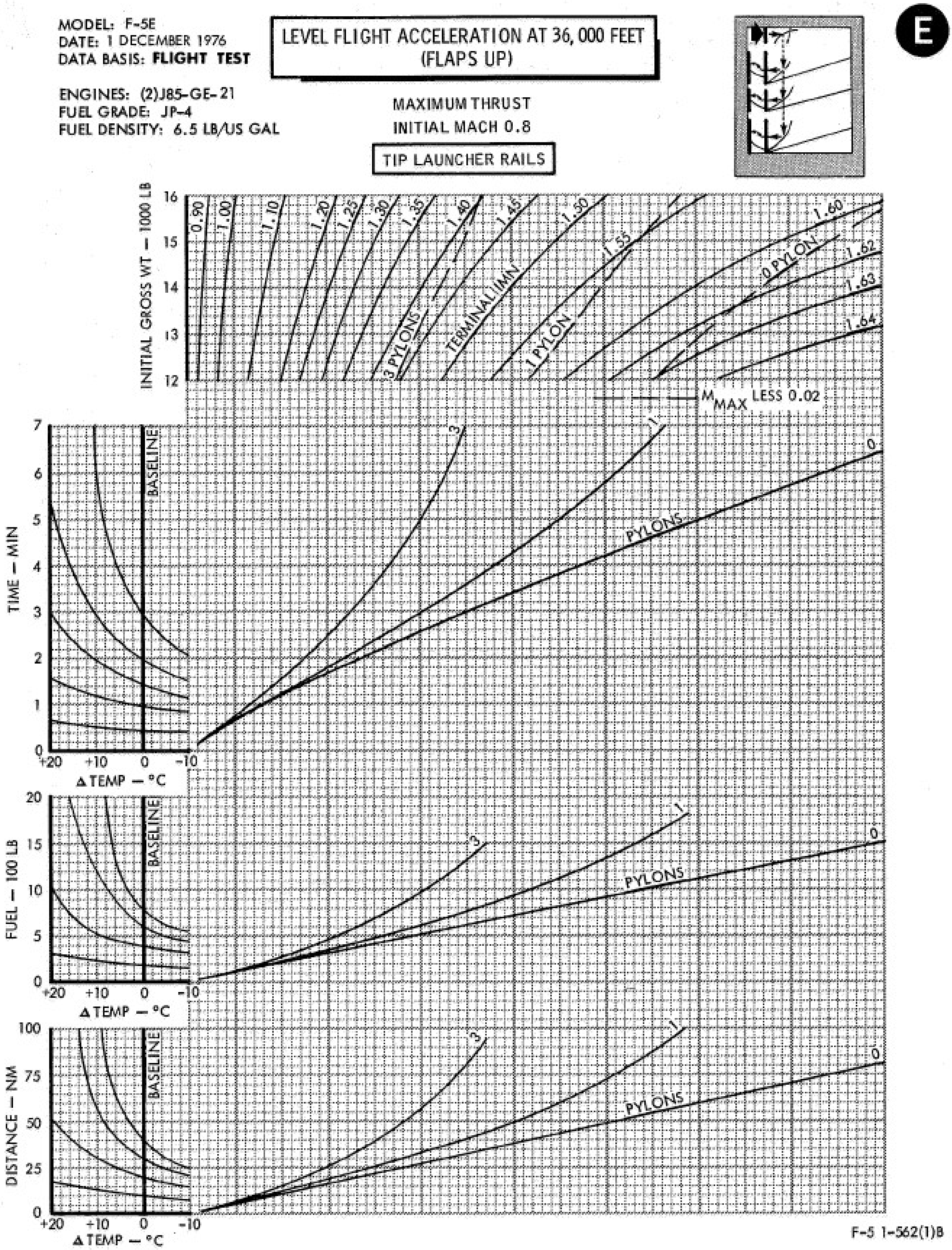
MODEL: F-5E
DATE: 1 DECEMBER 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2)J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

LEVEL FLIGHT ACCELERATION AT 36,000 FEET (FLAPS UP)

MAXIMUM THRUST
INITIAL MACH 0.8

TIP LAUNCHER RAILS



FA8-4 (Sheet 1).

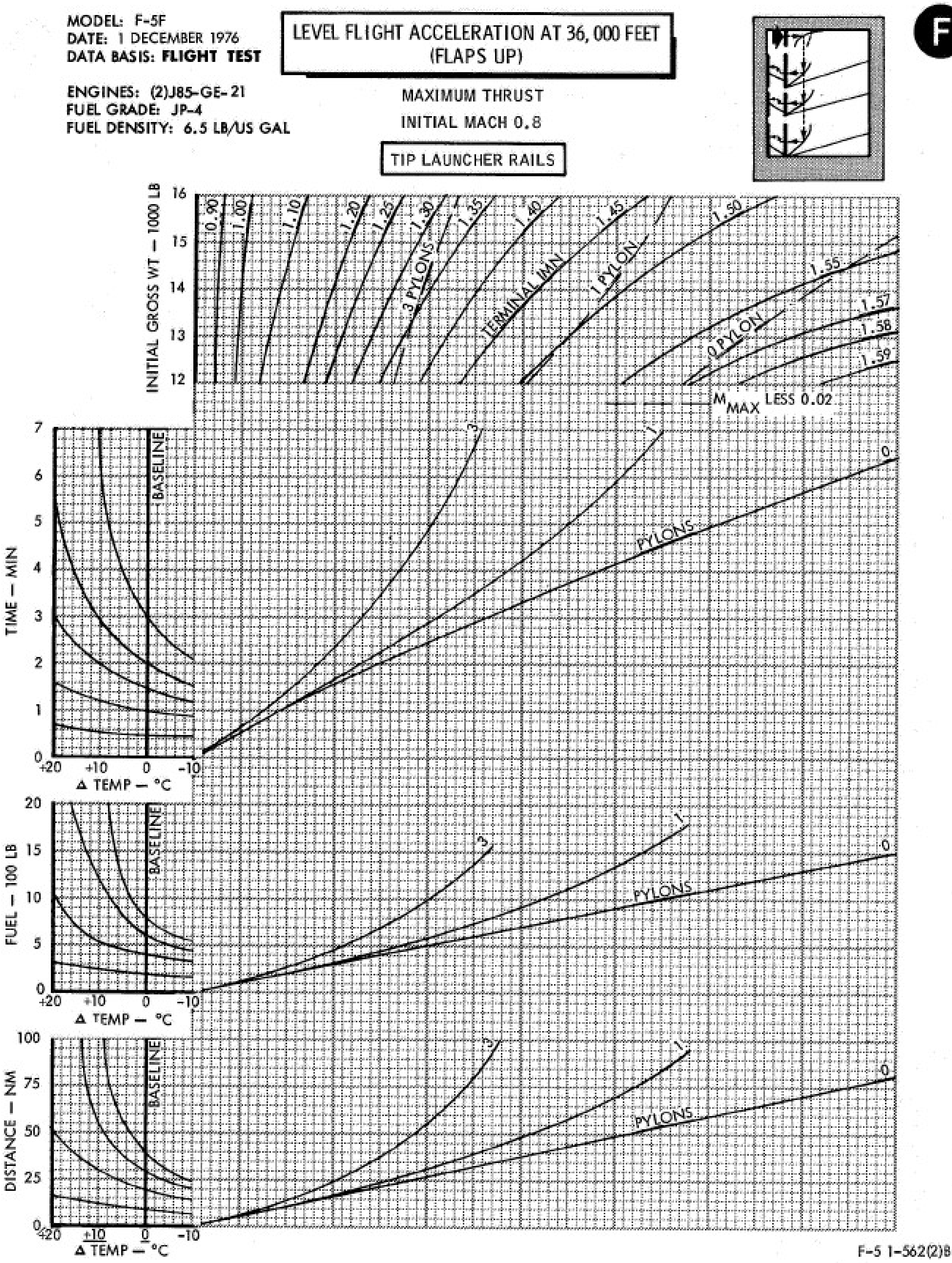
MODEL: F-5F
DATE: 1 DECEMBER 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2)J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

LEVEL FLIGHT ACCELERATION AT 36,000 FEET (FLAPS UP)

MAXIMUM THRUST
INITIAL MACH 0.8

TIP LAUNCHER RAILS



FA8-4 (Sheet 2).

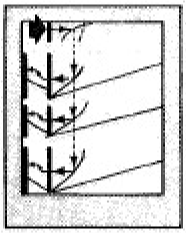
MODEL: F-5E
DATE: 1 DECEMBER 1976
DATA BASIS: **FLIGHT TEST**

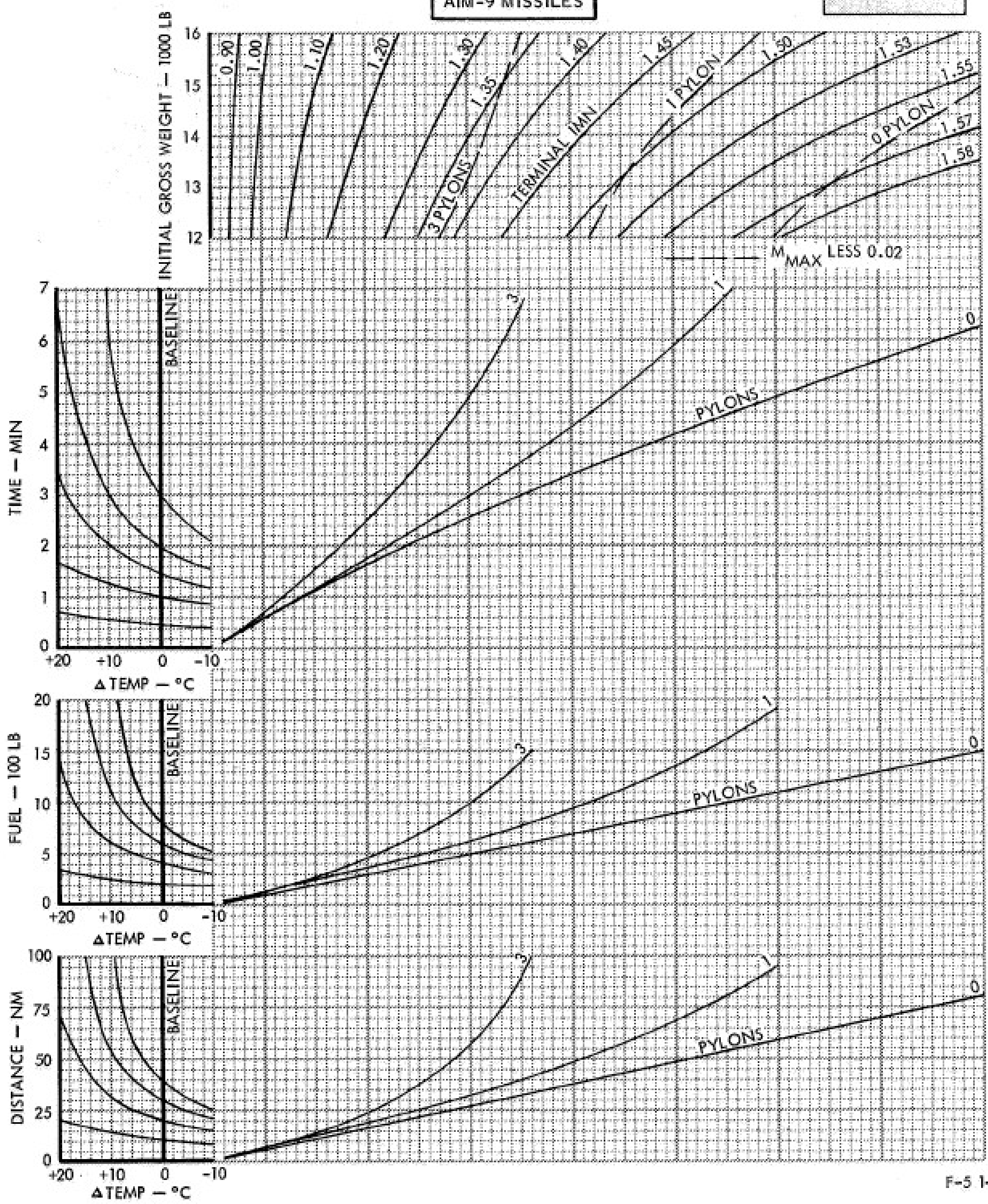
ENGINES: (2)J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

LEVEL FLIGHT ACCELERATION AT 36,000 FEET (FLAPS UP)

MAXIMUM THRUST
INITIAL MACH 0.8

AIM-9 MISSILES





F-5 1-564(1)B

FA8-5 (Sheet 1).

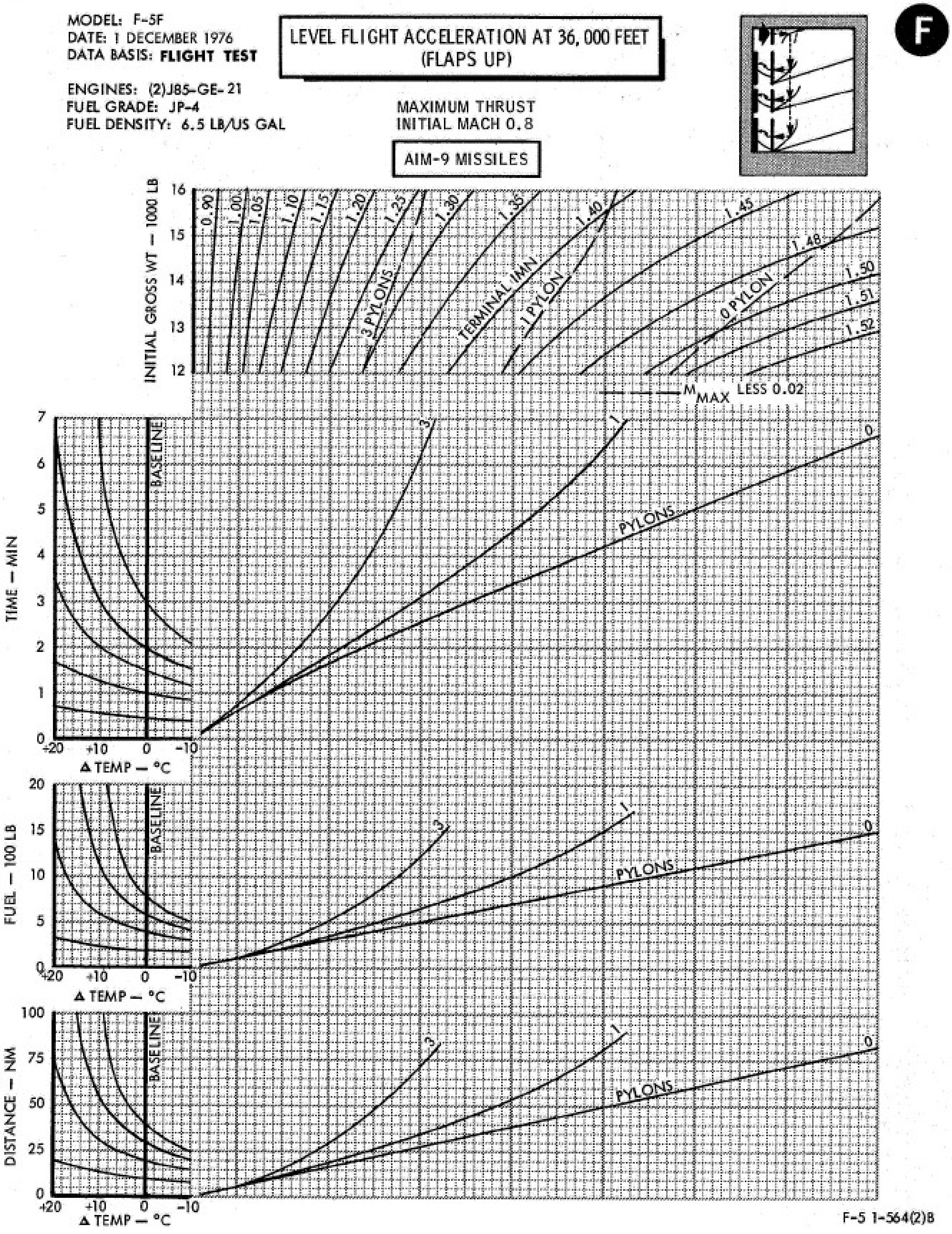
MODEL: F-5F
DATE: 1 DECEMBER 1976
DATA BASIS: FLIGHT TEST

ENGINES: (2)J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

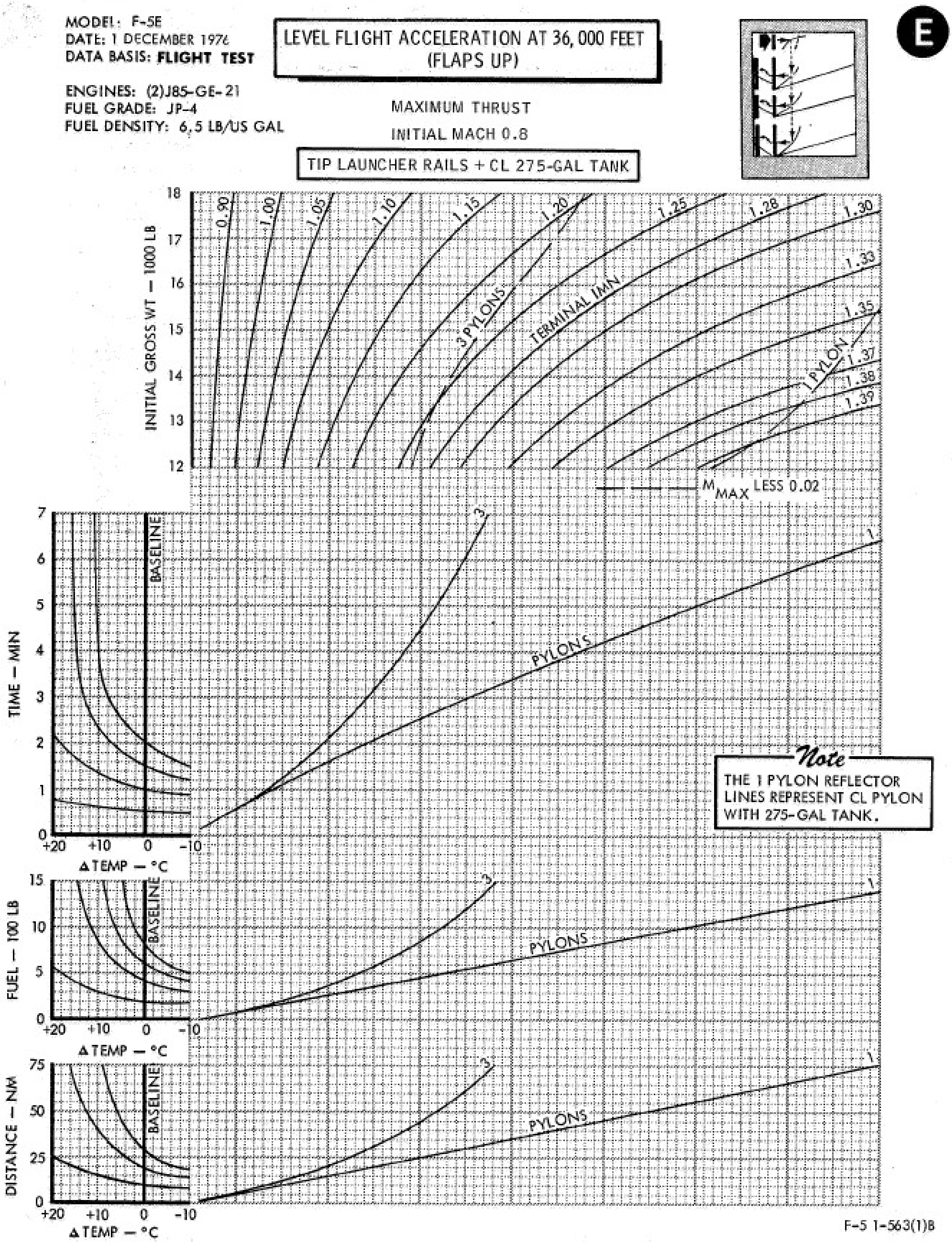
LEVEL FLIGHT ACCELERATION AT 36,000 FEET (FLAPS UP)

MAXIMUM THRUST
INITIAL MACH 0.8

AIM-9 MISSILES



FA8-5 (Sheet 2).


MODEL: F-5E
DATE: 1 DECEMBER 1976
DATA BASIS: FLIGHT TEST
ENGINES: (2)J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL
LEVEL FLIGHT ACCELERATION AT 36,000 FEET
(FLAPS UP)
MAXIMUM THRUST
INITIAL MACH 0.8
TIP LAUNCHER RAILS + CL 275-GAL TANK
E
INITIAL GROSS WT — 1000 LB
0.90
1.00
1.05
1.10
1.15
1.20
1.25
1.28
1.30
1.33
1.35
1.37
1.38
1.39
3 PYLONS
TERMINAL IMN
1 PYLON
M_{MAX} LESS 0.02
TIME — MIN
FUEL — 100 LB
DISTANCE — NM
BASELINE
Δ TEMP — °C
3 PYLONS
1 PYLONS
Note
THE 1 PYLON REFLECTOR LINES REPRESENT CL PYLON WITH 275-GAL TANK.
F-5 1-563(1)B

FA8-6 (Sheet 1).

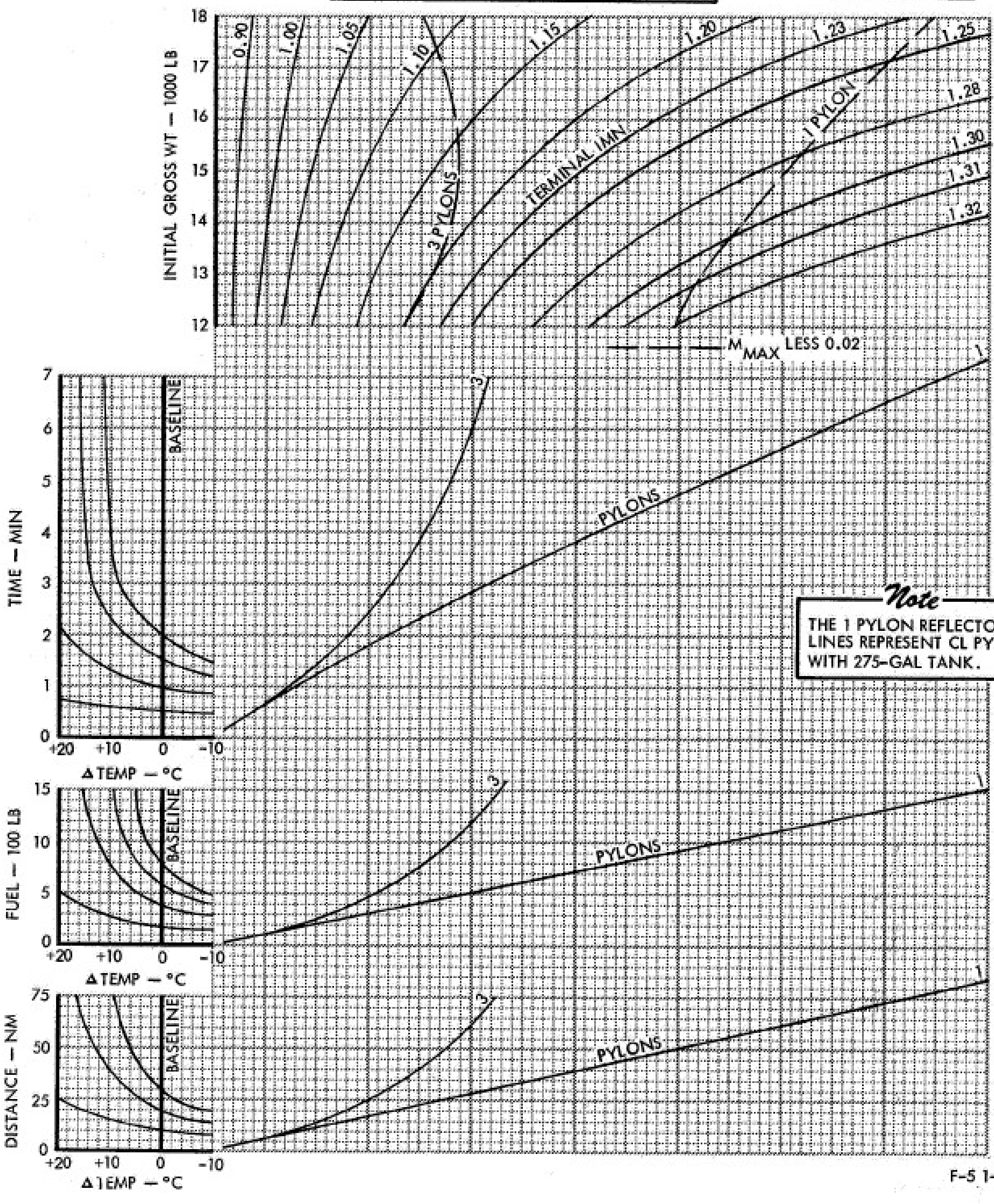
MODEL: F-5F
DATE: 1 DECEMBER 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2)J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

LEVEL FLIGHT ACCELERATION AT 36,000 FEET (FLAPS UP)

MAXIMUM THRUST
INITIAL MACH 0.8

TIP LAUNCHER RAILS + CL 275-GAL TANK



Note

THE 1 PYLON REFLECTOR LINES REPRESENT CL PYLON WITH 275-GAL TANK.

F-5 1-563(2)B

FA8-6 (Sheet 2).

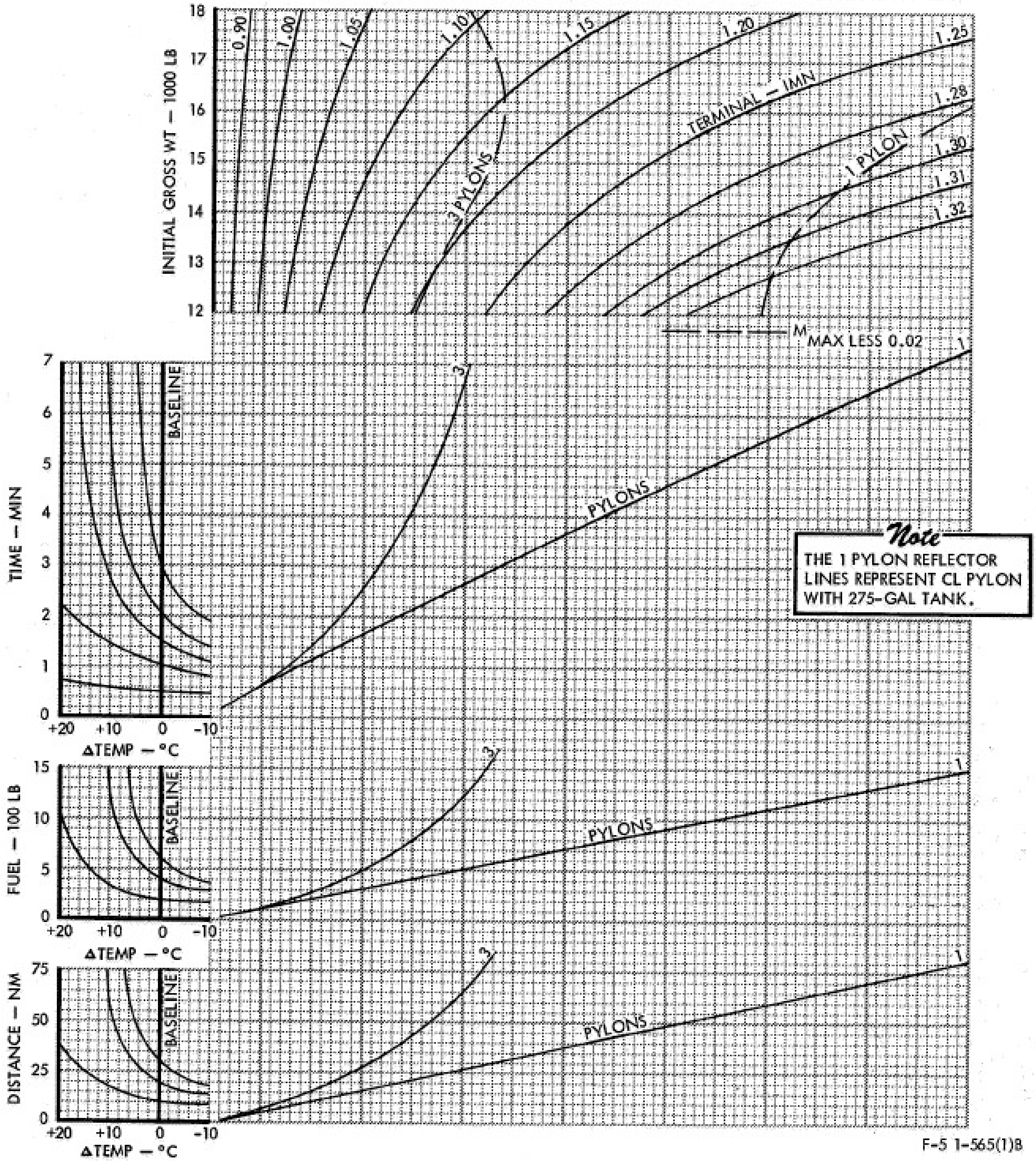
MODEL: F-5E
DATE: 1 DECEMBER 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2)J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

LEVEL FLIGHT ACCELERATION AT 36,000 FEET (FLAPS UP)

MAXIMUM THRUST
INITIAL MACH 0.8

AIM-9 MISSILES + CL 275-GAL TANK



F-5 1-565(1)B

FA8-7 (Sheet 1).

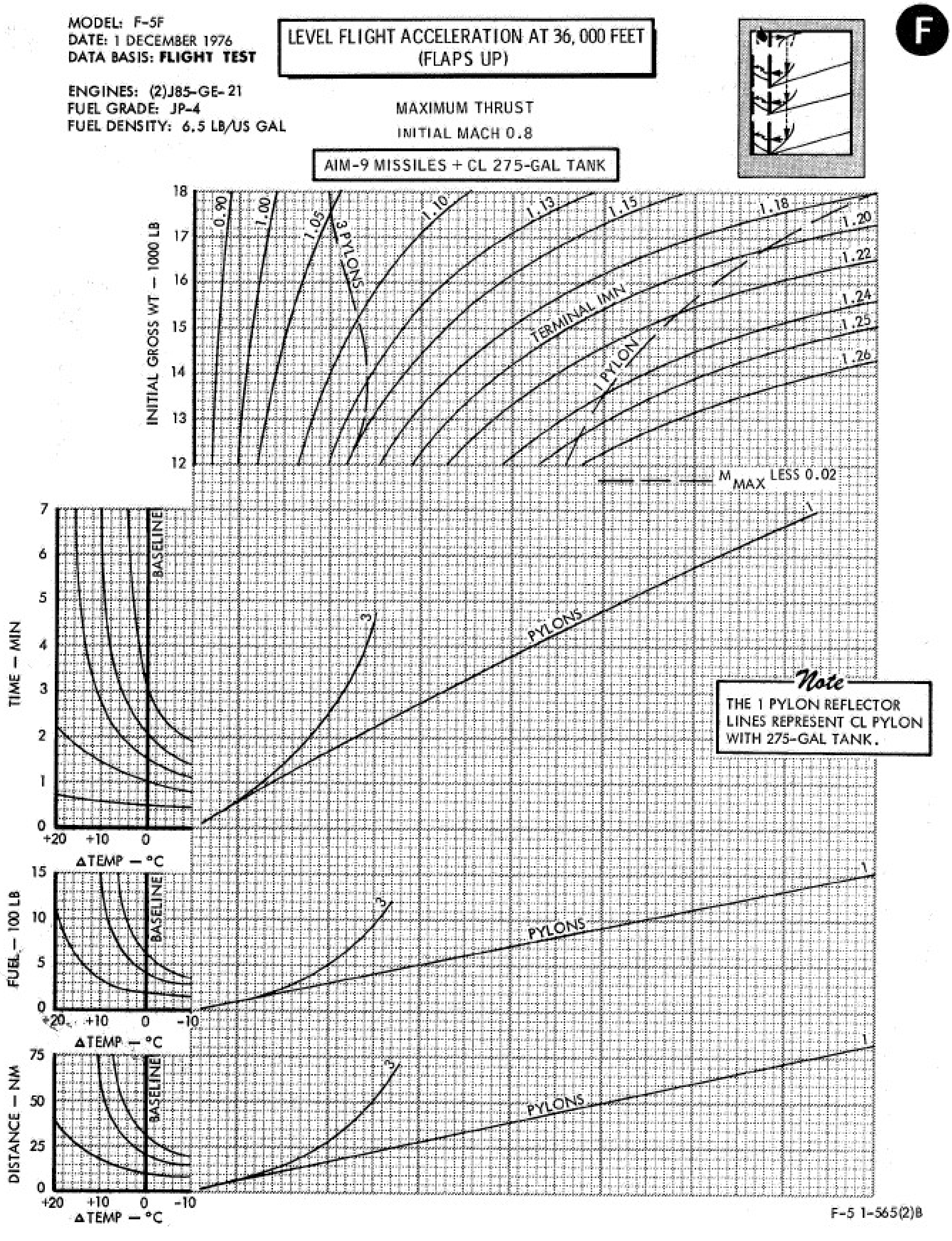
MODEL: F-5F
DATE: 1 DECEMBER 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2)J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

LEVEL FLIGHT ACCELERATION AT 36,000 FEET (FLAPS UP)

MAXIMUM THRUST
INITIAL MACH 0.8

AIM-9 MISSILES + CL 275-GAL TANK



FA8-7 (Sheet 2).

MODEL: F-5E
DATE: 1 JUNE 1973
DATA BASIS: **ESTIMATED**

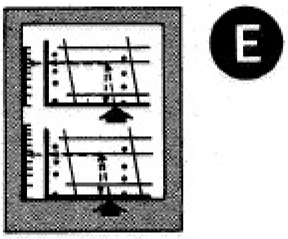
ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

SUPERSONIC ZOOM CLIMB FROM 36,089 FEET (FLAPS UP)

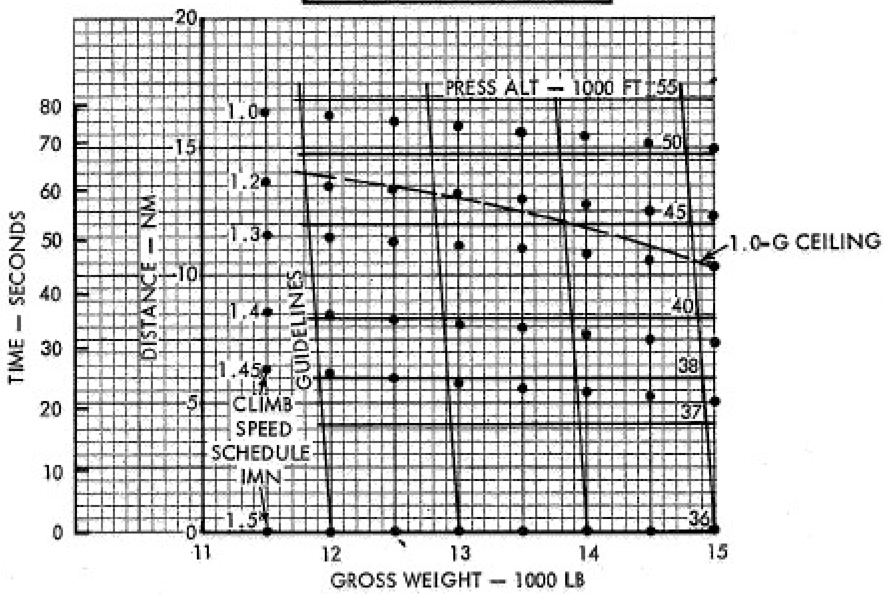
(2) AIM-9 MISSILES

STANDARD DAY

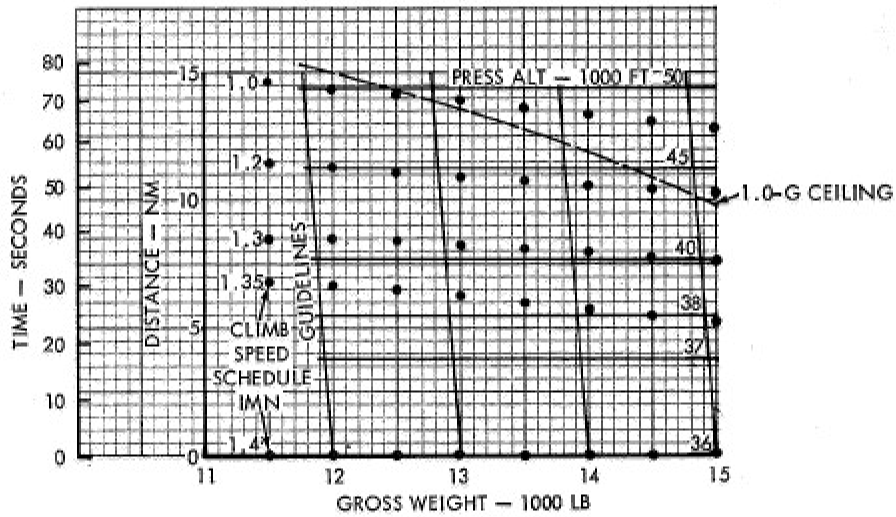
MAXIMUM THRUST



START CLIMB SPEED 1.5 IMN



START CLIMB SPEED 1.4 IMN



F-5 1-599(20)

FA8-8 (Sheet 1).

MODEL: F-5F
DATE: 1 AUGUST 1974
DATA BASIS: **ESTIMATED**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

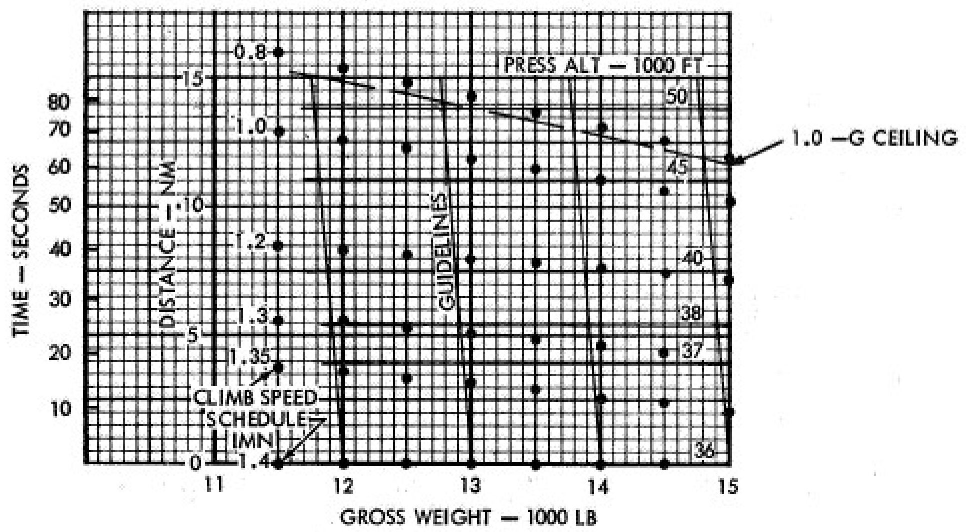
SUPERSONIC ZOOM CLIMB FROM 36,000 FEET (FLAPS UP)

(2) AIM-9 MISSILES

STANDARD DAY

MAXIMUM THRUST

START CLIMB SPEED 1.4 IMN



F-5 1-599(21)

FA8-8 (Sheet 2).

MODEL: F-5E
DATE: 1 AUGUST 1976
DATA BASIS: **FLIGHT TEST**

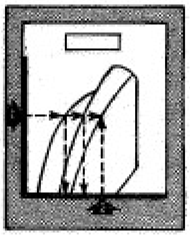
ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

LEVEL FLIGHT COMBAT SPEED

TIP LAUNCHER RAILS

GROSS WEIGHT 13,300 POUNDS

MANEUVERING FLAPS



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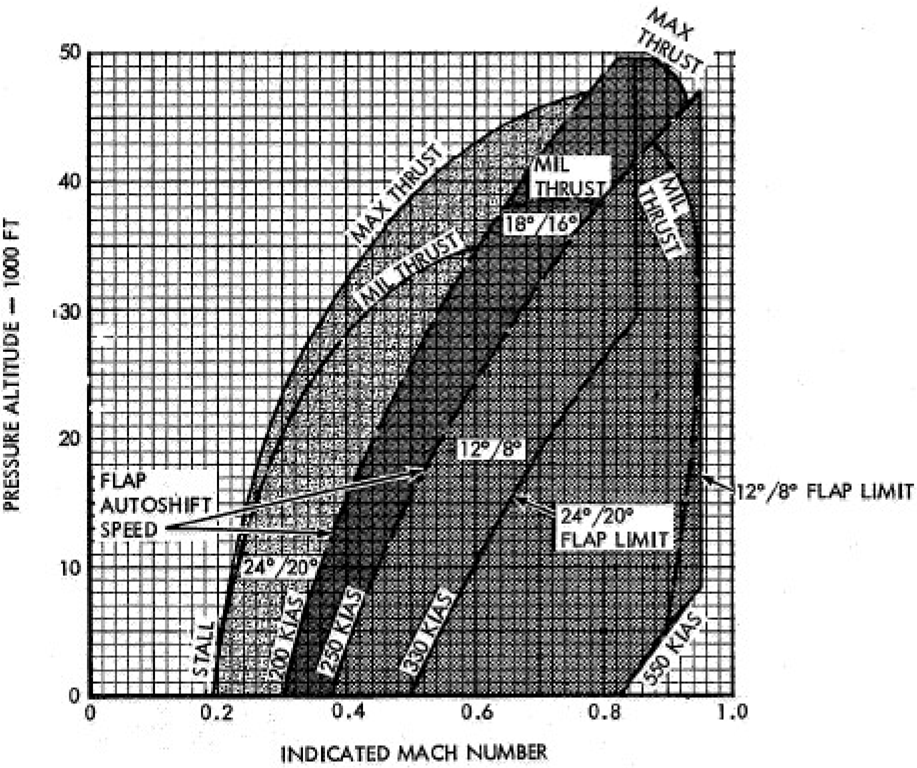
Note

CHART DATA BASED ON STANDARD DAY CONDITIONS.



F-5 1-539(1)B

FA8-9 (Sheet 1).

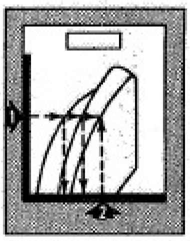
MODEL: F-5F
DATE: 1 AUGUST 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

LEVEL FLIGHT COMBAT SPEED

TIP LAUNCHER RAILS
GROSS WEIGHT 13,800 POUNDS

MANEUVERING FLAPS



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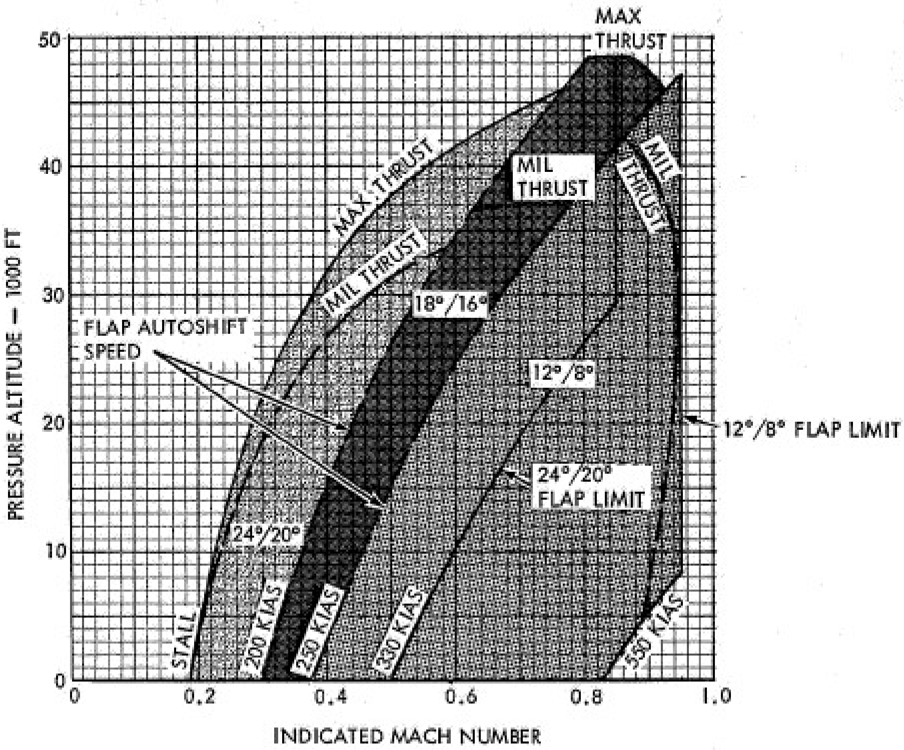
Note

CHART DATA BASED ON STANDARD DAY CONDITIONS.



F-5 1-539(2)B

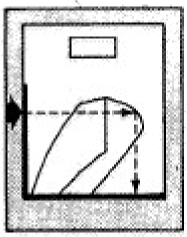
FA8-9 (Sheet 2)

MODEL: F-5E
DATE: 1 AUGUST 1976
DATA BASIS: **FLIGHT TEST**
ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

LEVEL FLIGHT COMBAT SPEED

TIP LAUNCHER RAILS
GROSS WEIGHT 13,300 POUNDS

FLAPS UP



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Note

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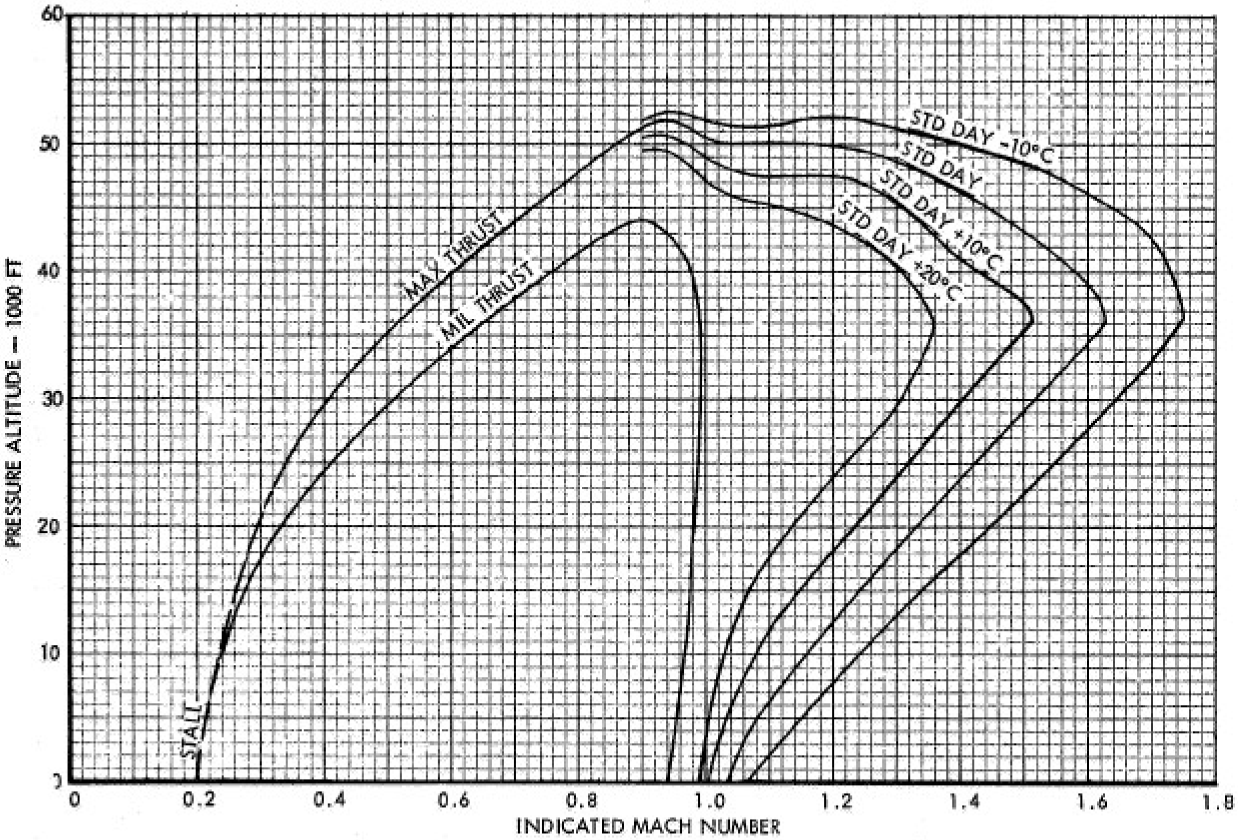

F-5 1-535(1)B

FA8-10 (Sheet 1).

MODEL: F-5F
DATE: 1 AUGUST 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

LEVEL FLIGHT COMBAT SPEED

TIP LAUNCHER RAILS
GROSS WEIGHT 13,800 POUNDS

FLAPS UP

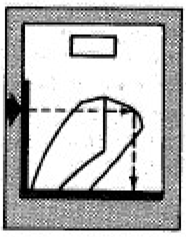

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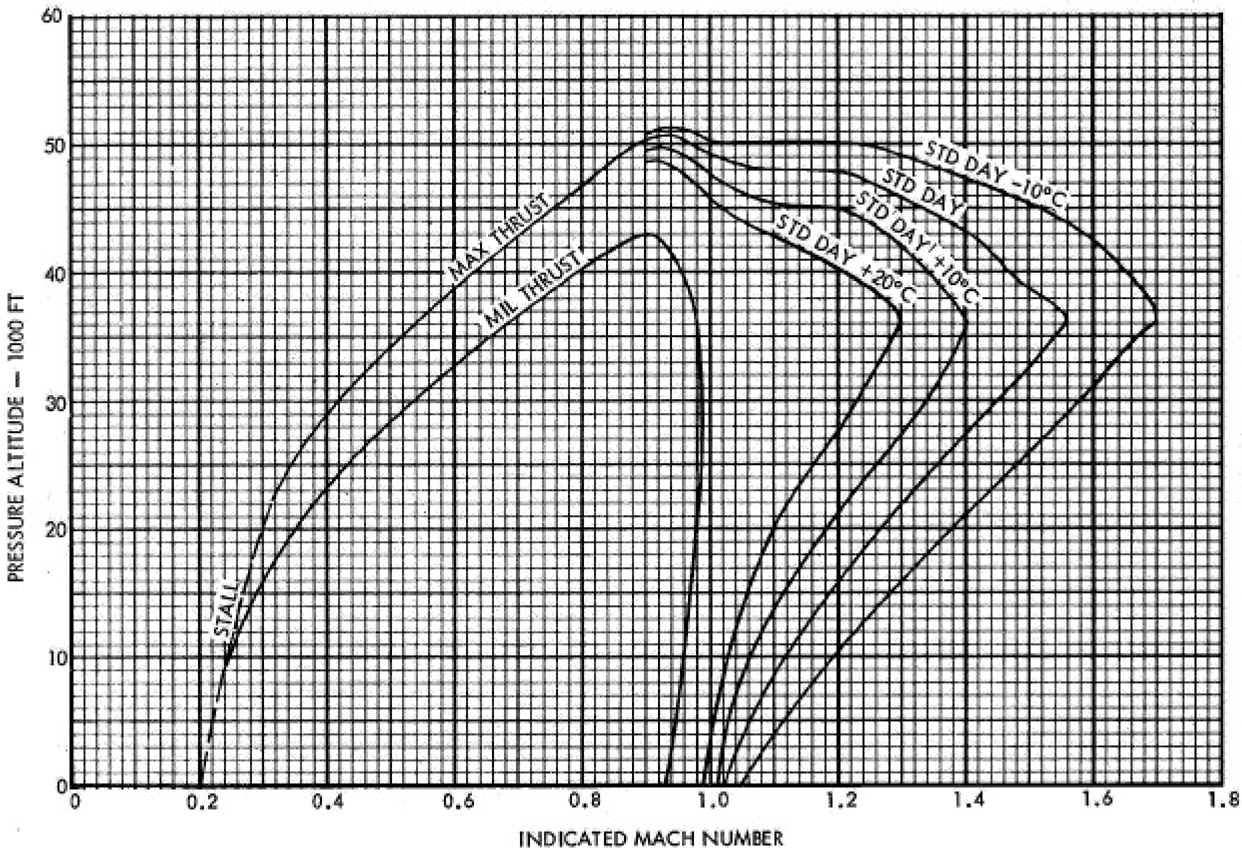
CHART DATA BELOW 0.90 MACH BASED ON STANDARD DAY CONDITIONS.



F-5 1-535(2)B

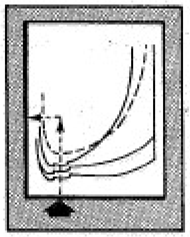
FA8-10 (Sheet 2).

MODEL: F-5E
DATE: 1 APRIL 1977
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

TURN PERFORMANCE

RADIUS
STANDARD DAY
(2) AIM-9 MISSILES, CL TANK, AND (4) MK-82 BOMBS
GROSS WEIGHT 17,500 POUNDS



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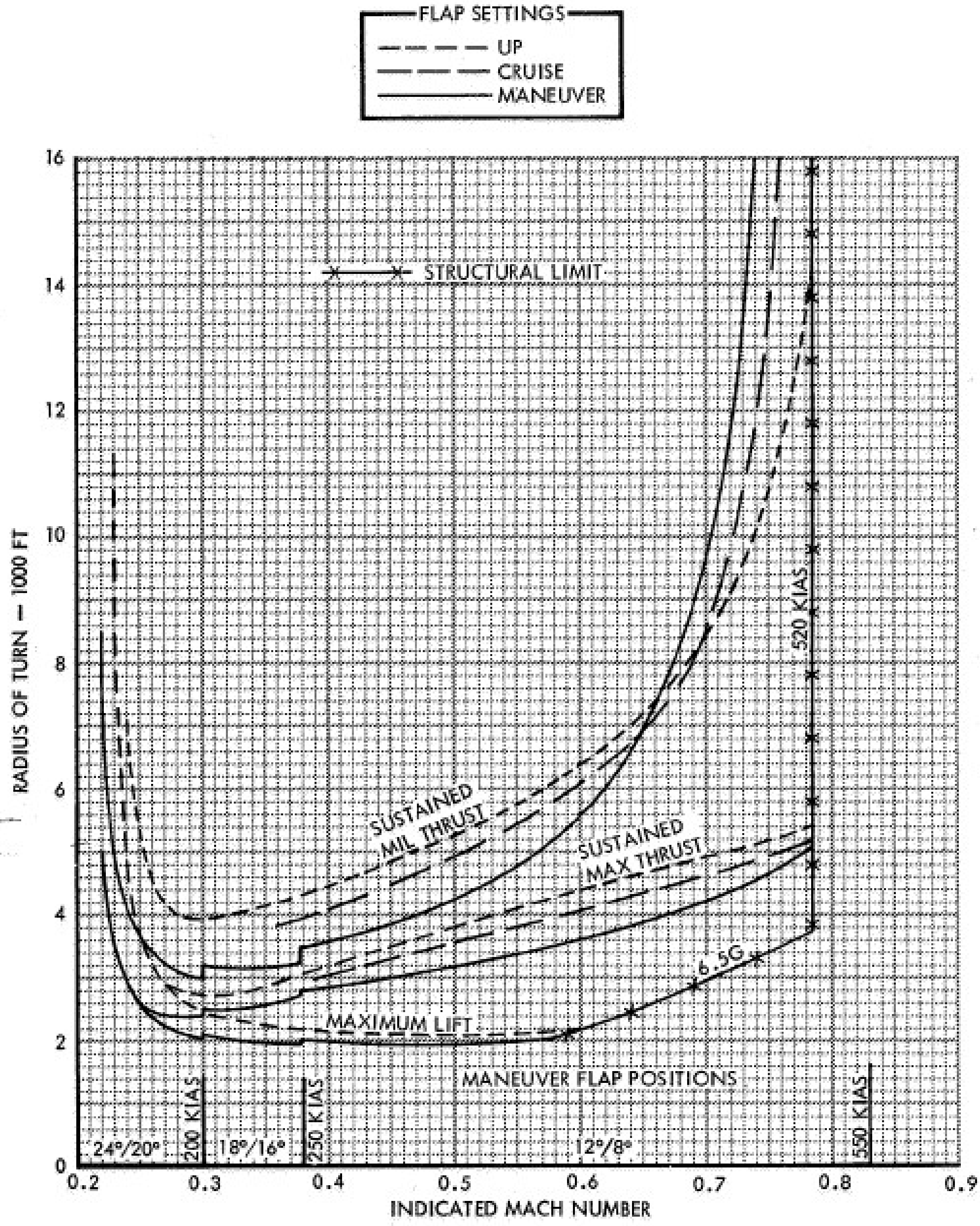
SEA LEVEL



F-5 1-603(1)B

FA8-11 (Sheet 1).

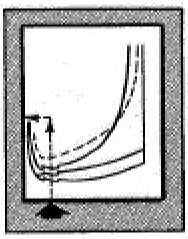
MODEL: F-5F
DATE: 1 APRIL 1977
DATA BASIS: **FLIGHT TEST**

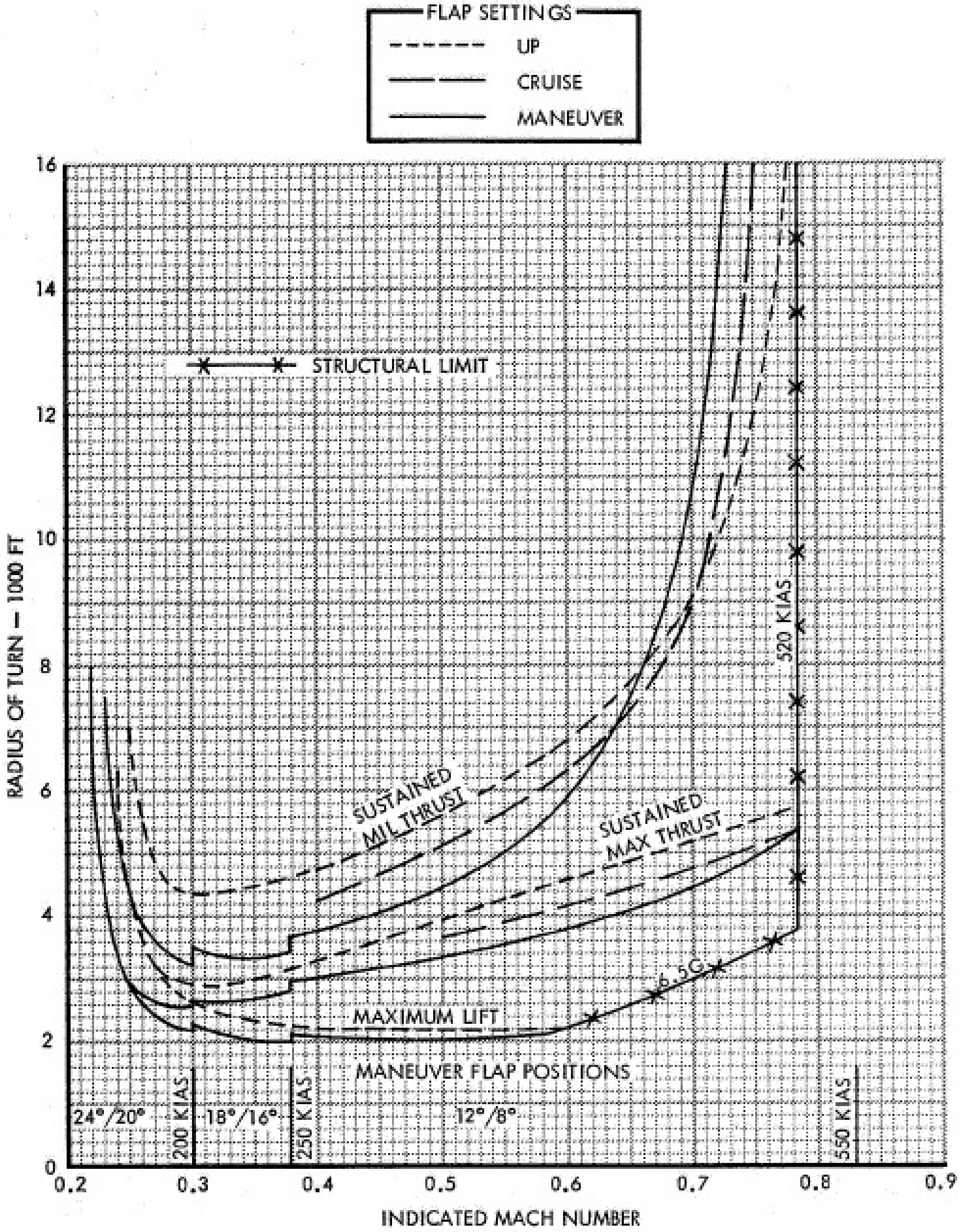
ENGINES: (2)J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

TURN PERFORMANCE

RADIUS
STANDARD DAY
(2) AIM-9 MISSILES, CL TANK,
AND (4) MK-82 BOMBS
GROSS WEIGHT 18,100 POUNDS

SEA LEVEL





F-5 1-603(2)B

FA8-11 (Sheet 2).

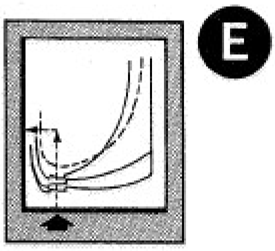
MODEL: F-5E
DATE: 1 APRIL 1977
DATA BASIS: **FLIGHT TEST**

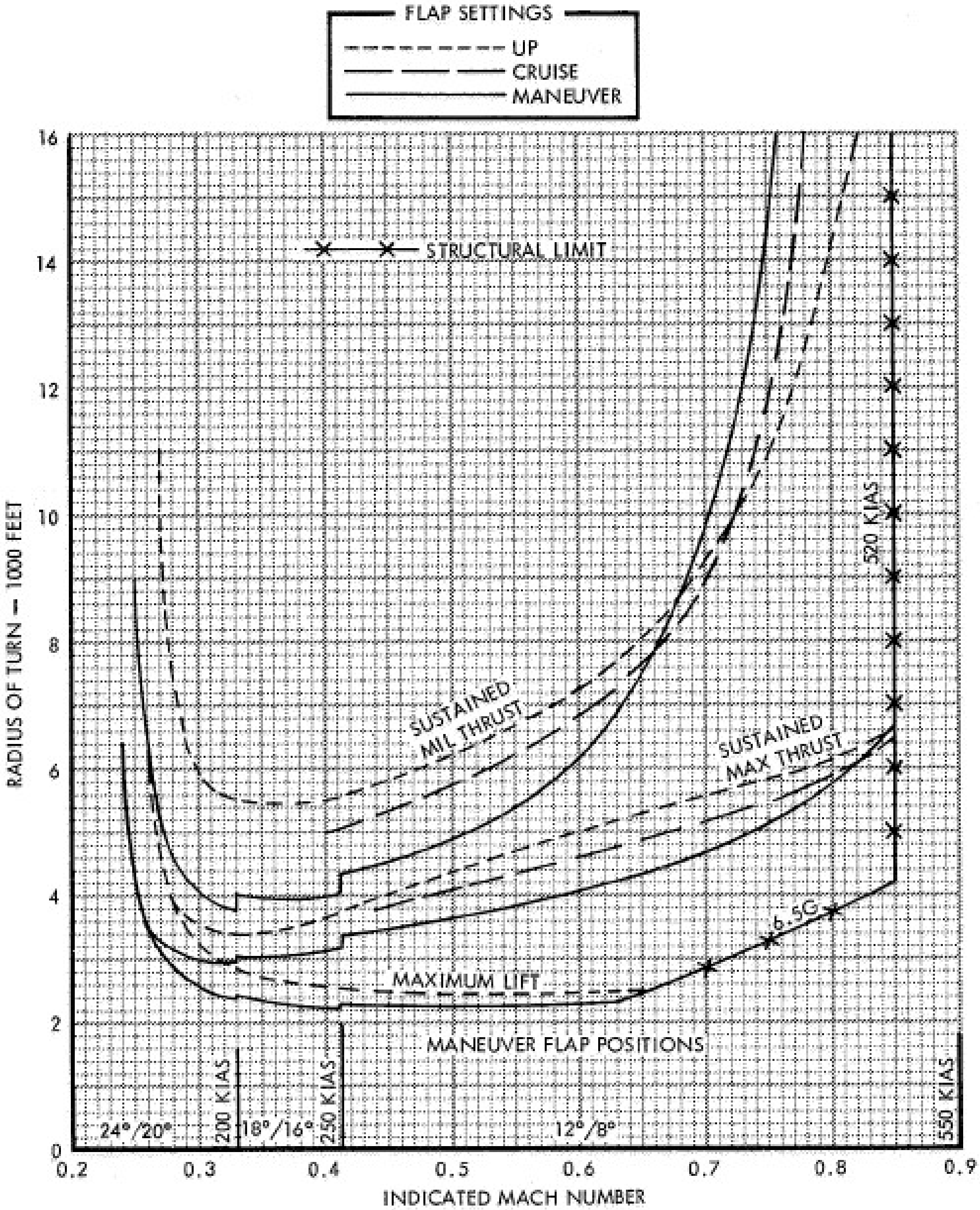
ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

TURN PERFORMANCE

RADIUS
STANDARD DAY
(2) AIM-9 MISSILES, CL TANK,
AND (4) MK-82 BOMBS
GROSS WEIGHT 17,500 POUNDS

5000 FEET





F-5 1-604(1)B

FA8-12 (Sheet 1).

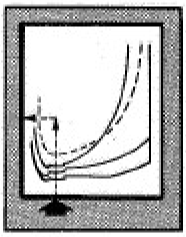
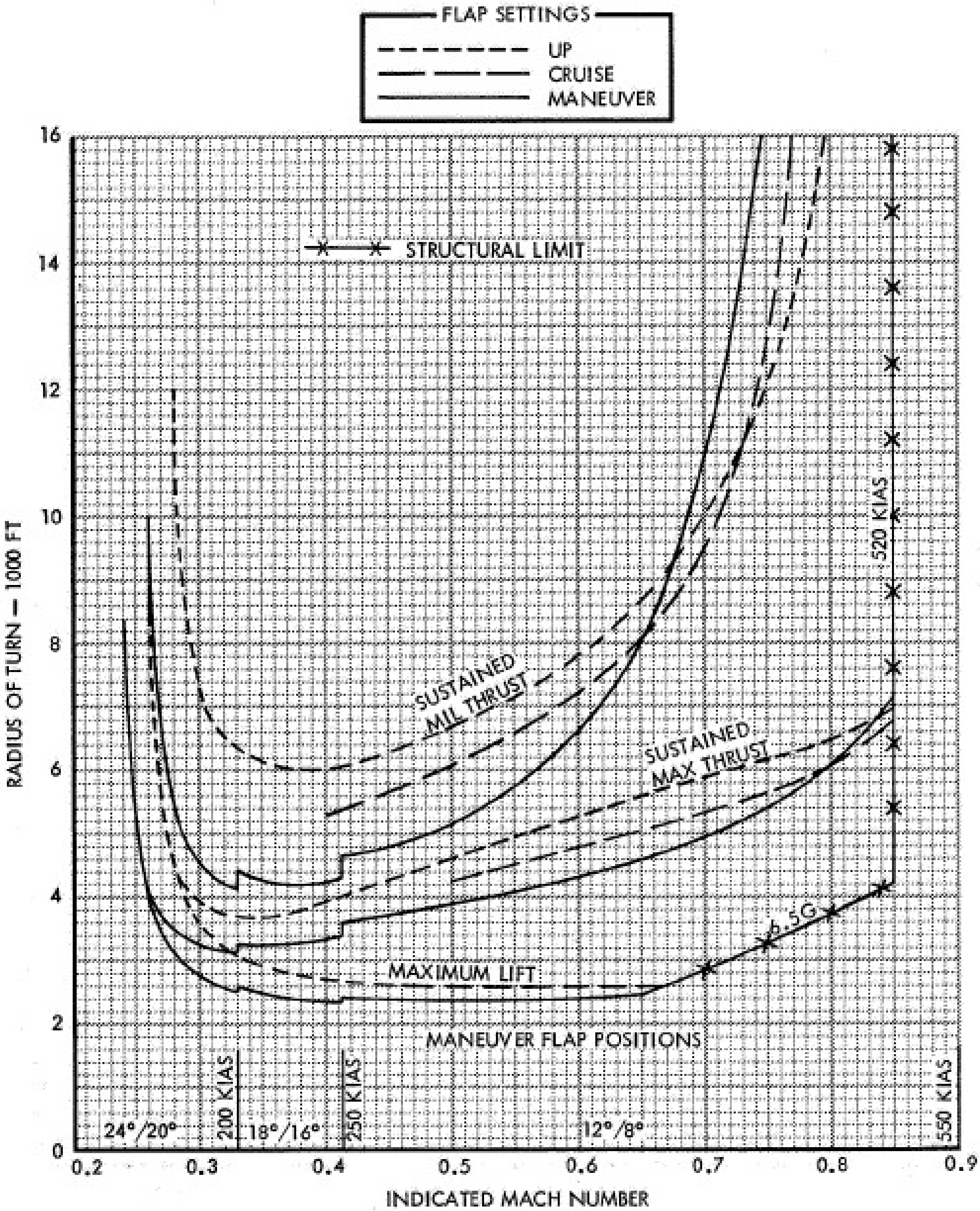
MODEL: F-5F
DATE: 1 APRIL 1977
DATA BASIS: **FLIGHT TEST**

ENGINES: (2)J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

TURN PERFORMANCE

RADIUS
STANDARD DAY
(2) AIM-9 MISSILES, CL TANK, AND (4) MK-82 BOMBS
GROSS WEIGHT 18,100 POUNDS

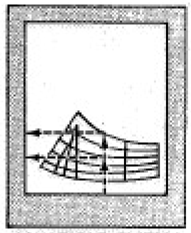
5000 FEET

F-5 1-604(2)D

FA8-12 (Sheet 2).

E



MULTIPLE ENTRY

MODEL: F-5E
DATE: 1 AUGUST 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

TURN PERFORMANCE

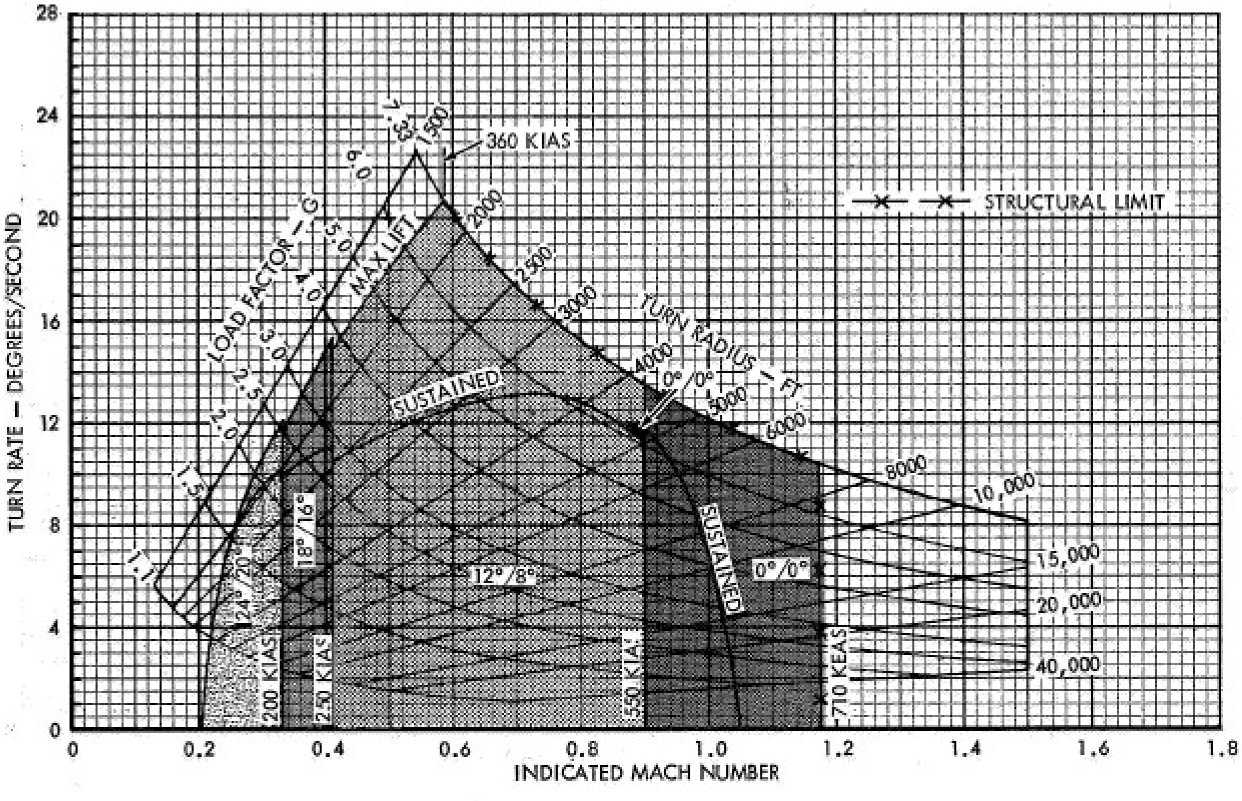
TURN RATE, TURN RADIUS,
AND LOAD FACTOR

MAXIMUM THRUST

STANDARD DAY

(2) AIM-9 MISSILES
GROSS WEIGHT 13,600 POUNDS

5000 FEET



F-5 1-600(1)B

FA8-13 (Sheet 1).

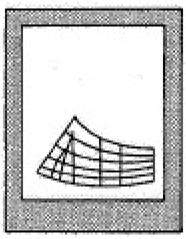
MODEL: F-5F
DATE: 1 AUGUST 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

TURN PERFORMANCE

TURN RATE, TURN RADIUS, AND LOAD FACTOR
MAXIMUM THRUST
STANDARD DAY
(2) AIM-9 MISSILES
GROSS WEIGHT 14,150 POUNDS

5000 FEET



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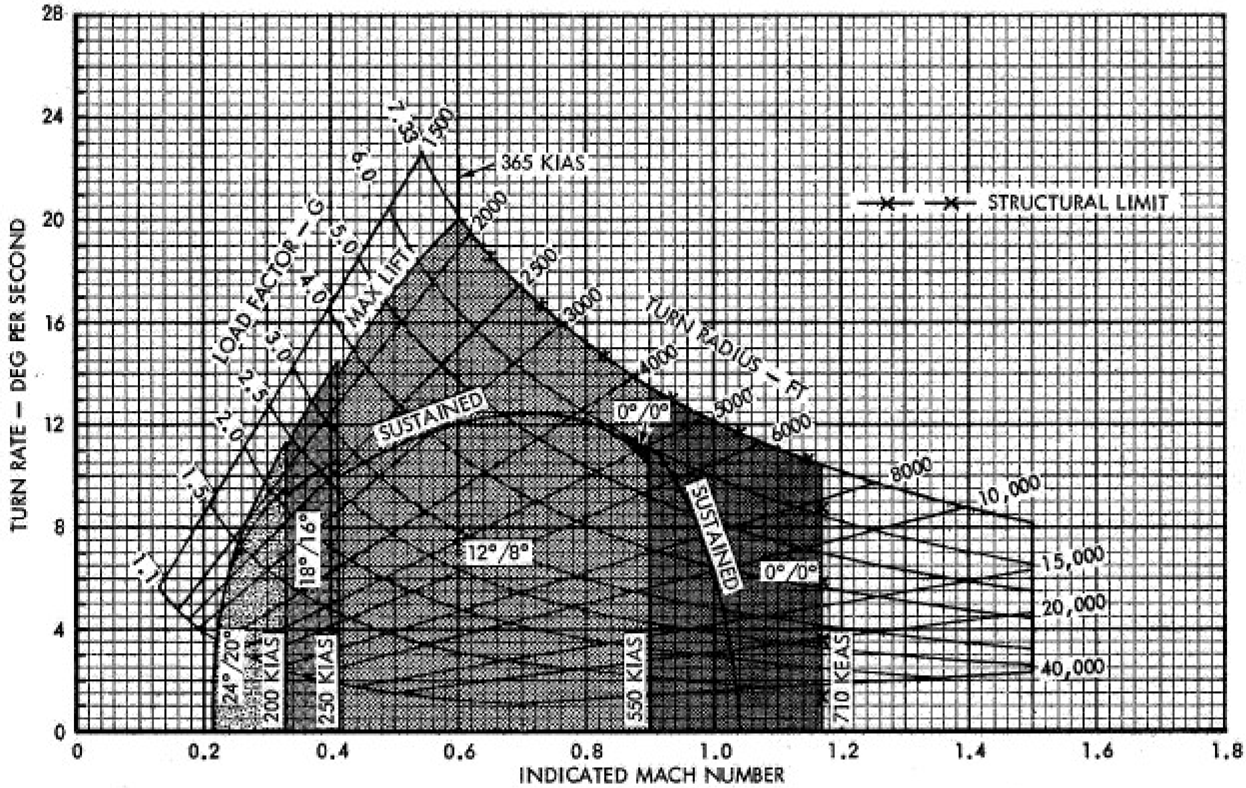


F-5 1-600(2)B

FA8-13 (Sheet 2).

MODEL: F-5E
DATE: 1 AUGUST 1976
DATA BASIS: **FLIGHT TEST**

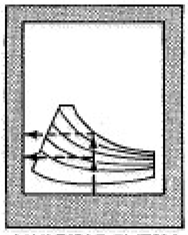
ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

TURN PERFORMANCE

TURN RATE, TURN RADIUS, AND LOAD FACTOR
MAXIMUM THRUST
STANDARD DAY
(2) AIM-9 MISSILES
GROSS WEIGHT 13,600 POUNDS

15,000 FEET

E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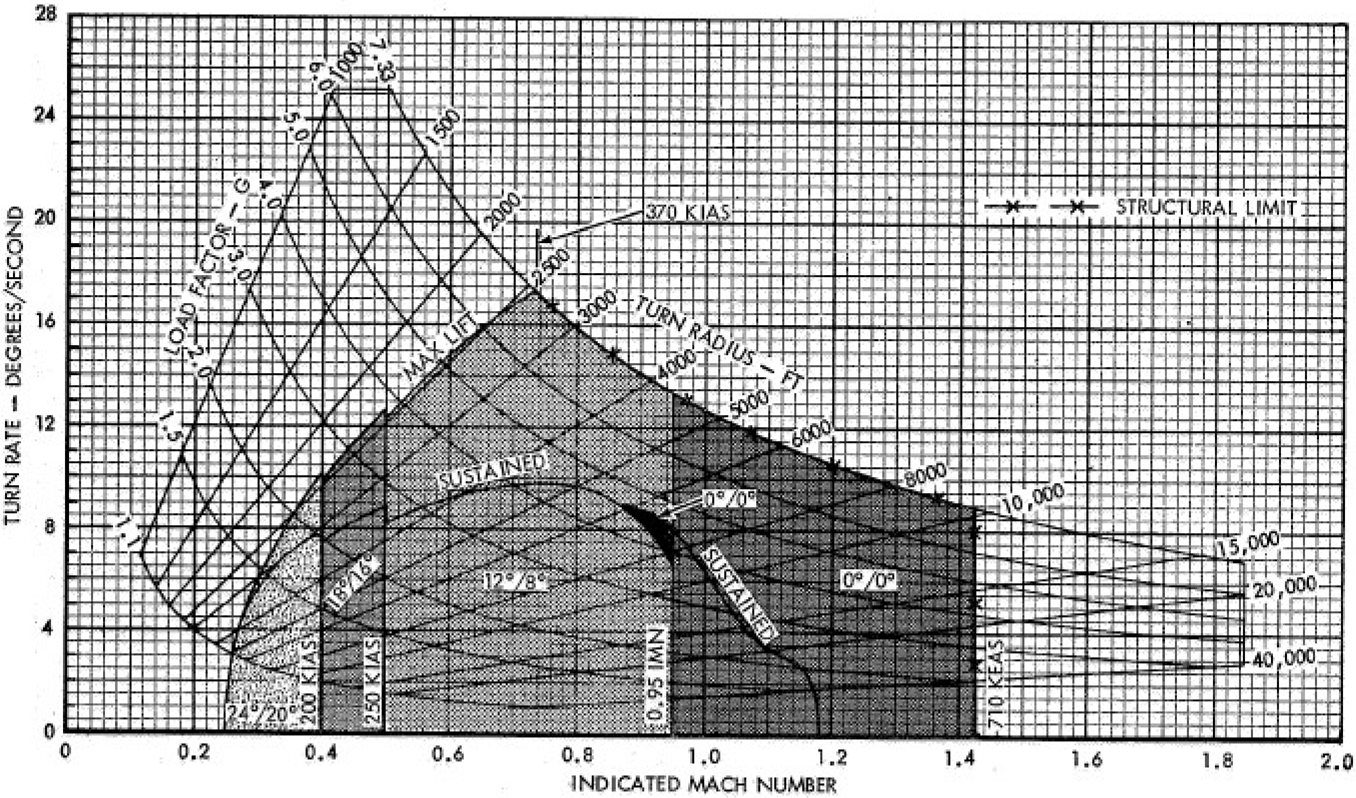


F-5 1-601(1)B

FA8-14 (Sheet 1).

MODEL: F-5F
DATE: 1 AUGUST 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

TURN PERFORMANCE

TURN RATE, TURN RADIUS, AND LOAD FACTOR

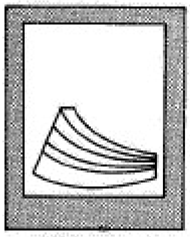
MAXIMUM THRUST

STANDARD DAY

(2) AIM-9 MISSILES

GROSS WEIGHT 14,150 POUNDS

15,000 FEET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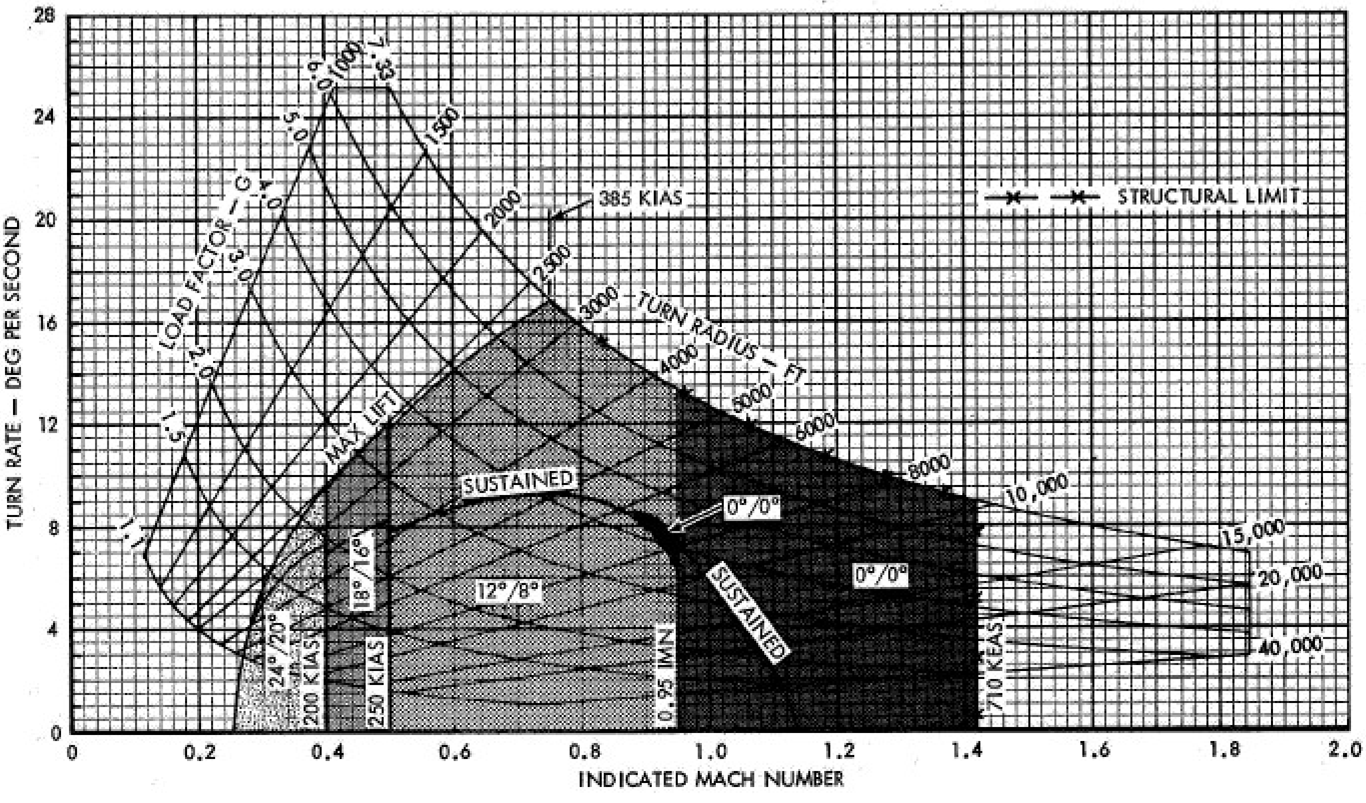


F-5 1-601(2)B

FA8-14 (Sheet 2).

MODEL: F-5E
DATE: 1 AUGUST 1976
DATA BASIS: **FLIGHT TEST**

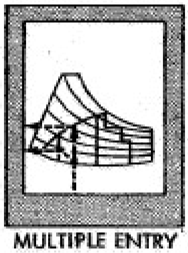
ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

TURN PERFORMANCE

TURN RATE, TURN RADIUS, AND LOAD FACTOR
MAXIMUM THRUST
STANDARD DAY
(2) AIM-9 MISSILES
GROSS WEIGHT 13,600 POUNDS

30,000 FEET

E



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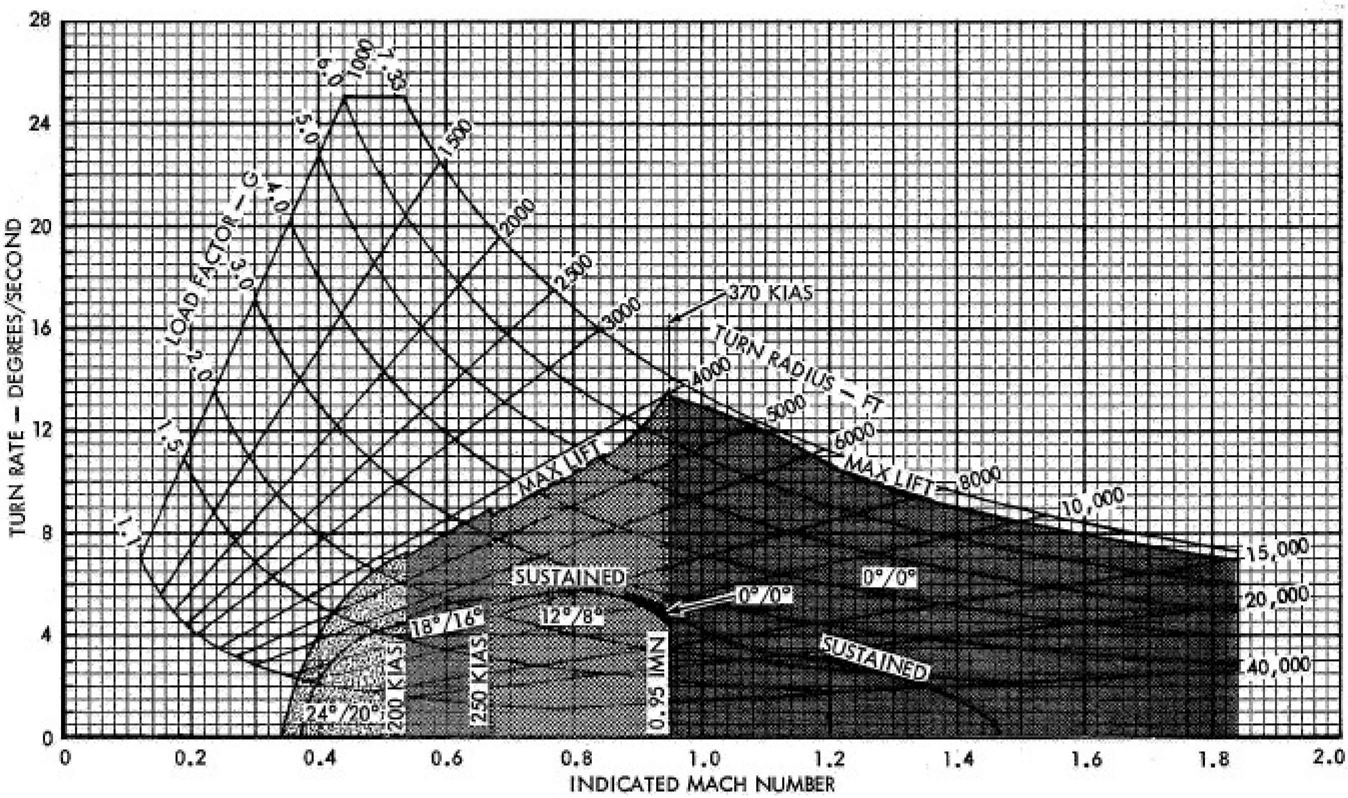


F-5 1-602(1)B

FA8-15 (Sheet 1).

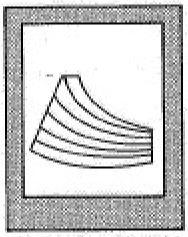
MODEL: F-5F
DATE: 1 AUGUST 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

TURN PERFORMANCE

TURN RATE, TURN RADIUS, AND LOAD FACTOR
MAXIMUM THRUST
STANDARD DAY
(2) AIM-9 MISSILES
GROSS WEIGHT 14,150 POUNDS

30,000 FEET



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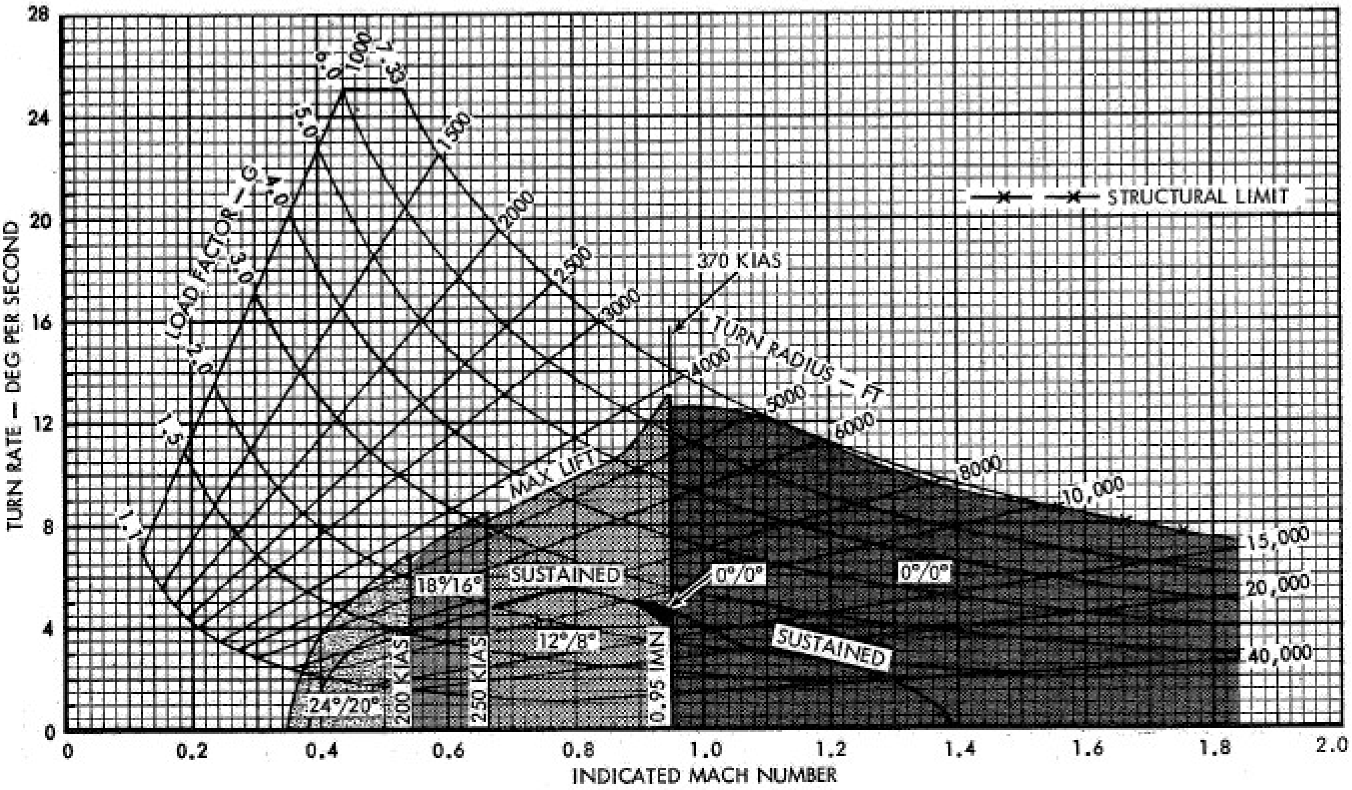
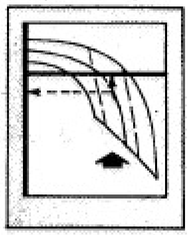


F-5 1-602(2)C

FA8-15 (Sheet 2).



E

MODEL: F-5E
DATE: 1 AUGUST 1976
DATA BASIS: **FLIGHT TEST**

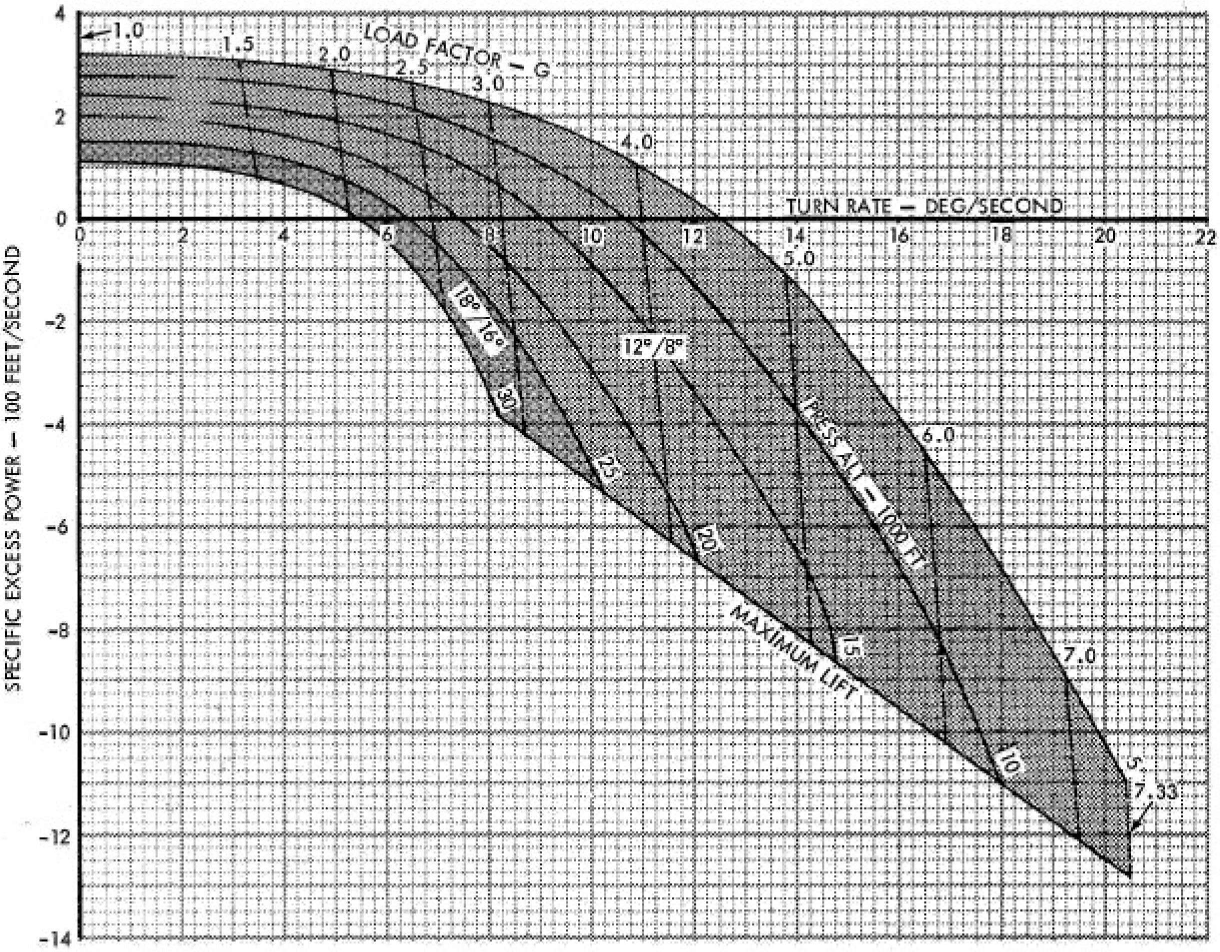
ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

TURN PERFORMANCE

SPECIFIC EXCESS POWER AND TURN RATE
MAXIMUM THRUST
STANDARD DAY
(2) AIM-9 MISSILES
GROSS WEIGHT 13,600 POUNDS

0.6 IMN

MANEUVERING FLAPS



F-5 1-605(1)B

FA8-16 (Sheet 1).

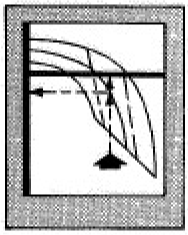
MODEL: F-5F
DATE: 1 AUGUST 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2)J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

TURN PERFORMANCE

SPECIFIC EXCESS POWER AND TURN RATE
MAXIMUM THRUST
STANDARD DAY
(2) AIM-9 MISSILES
GROSS WEIGHT 14,150 POUNDS

0.6 IMN



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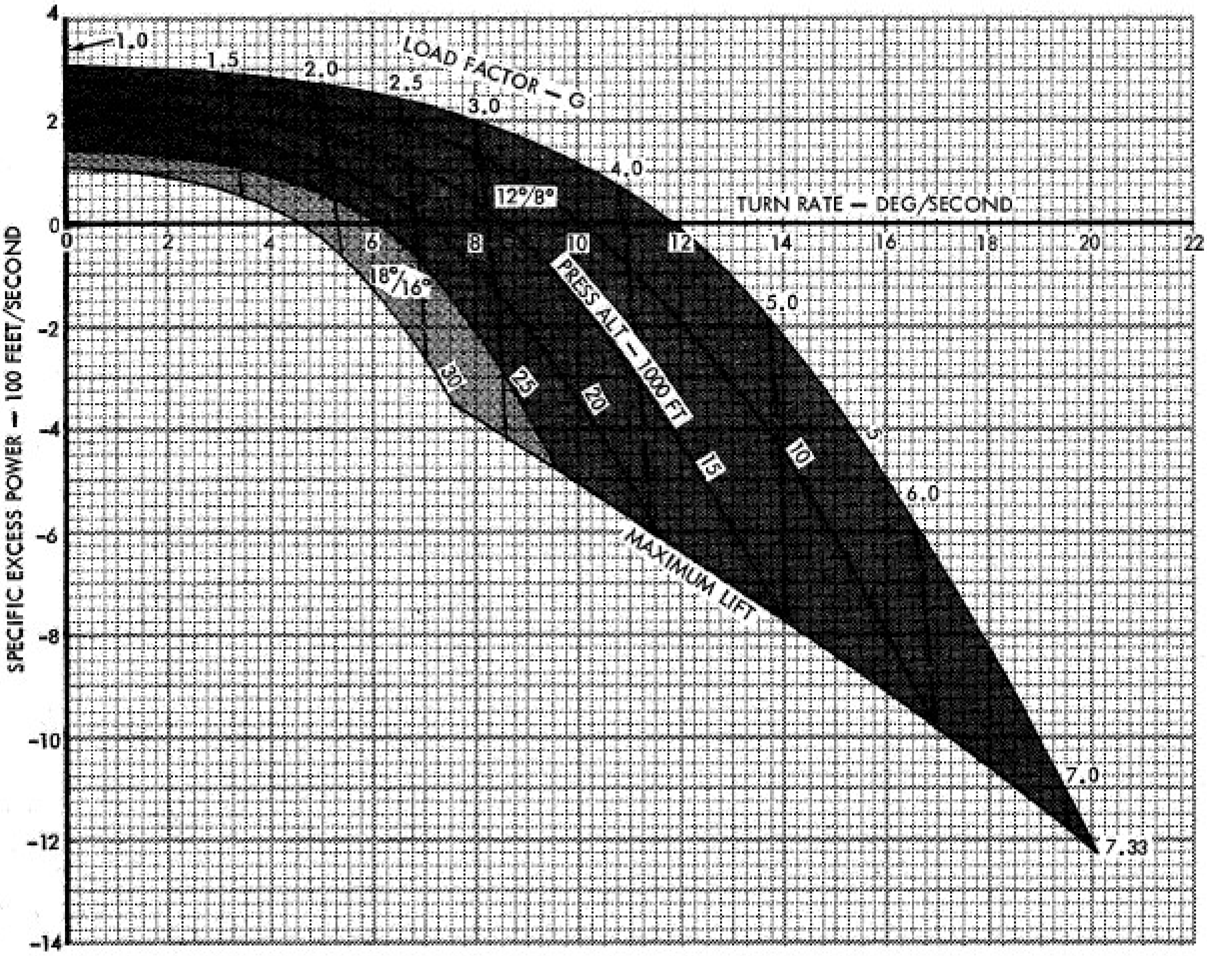
MANEUVERING FLAPS



F-5 1-605(2)C

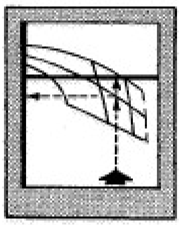
FA8-16 (Sheet 2).

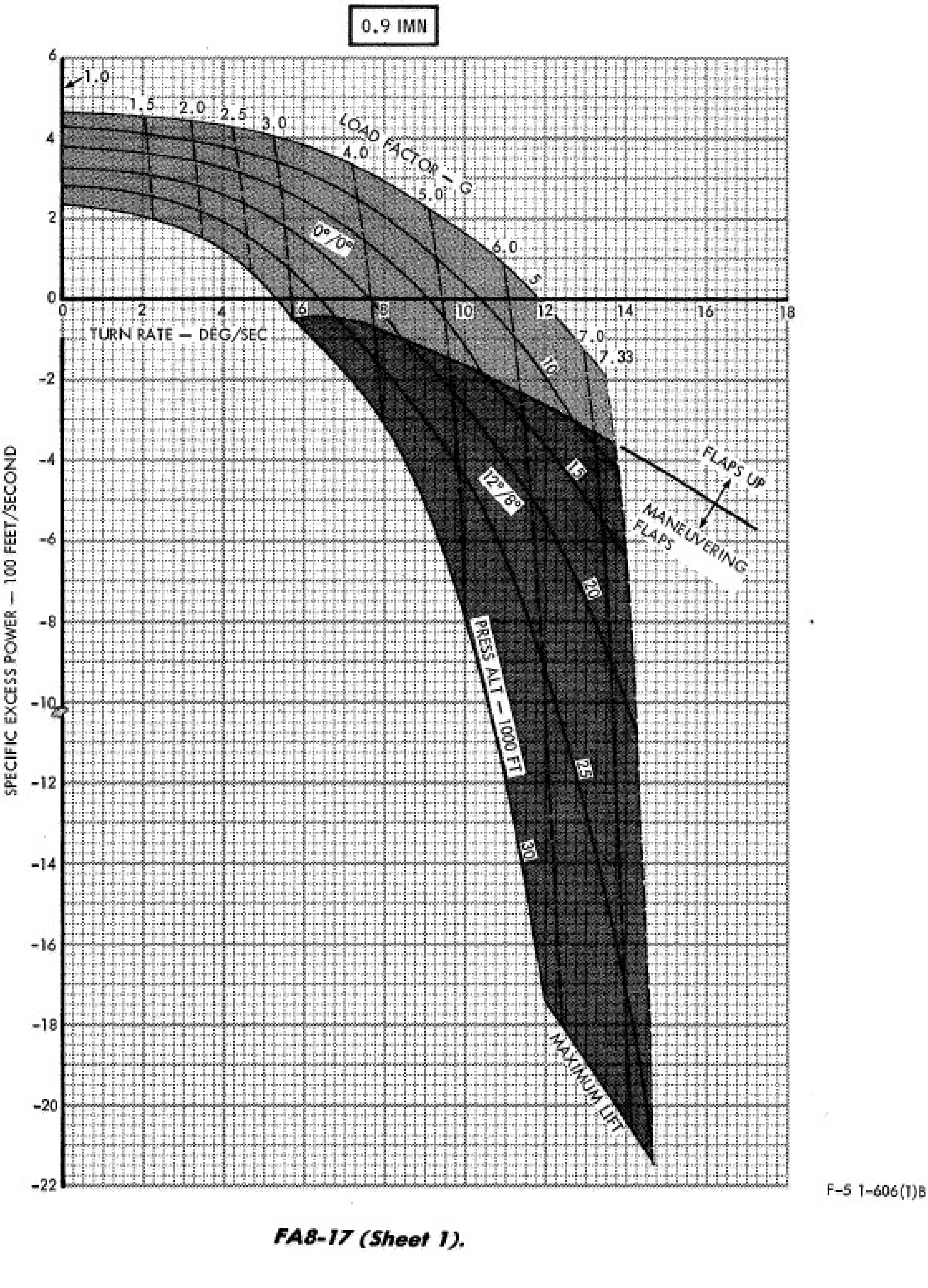
MODEL: F-5E
DATE: 1 AUGUST 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

TURN PERFORMANCE

SPECIFIC EXCESS POWER AND TURN RATE
MAXIMUM THRUST
STANDARD DAY
(2) AIM-9 MISSILES
GROSS WEIGHT 13,600 POUNDS





FA8-17 (Sheet 1).

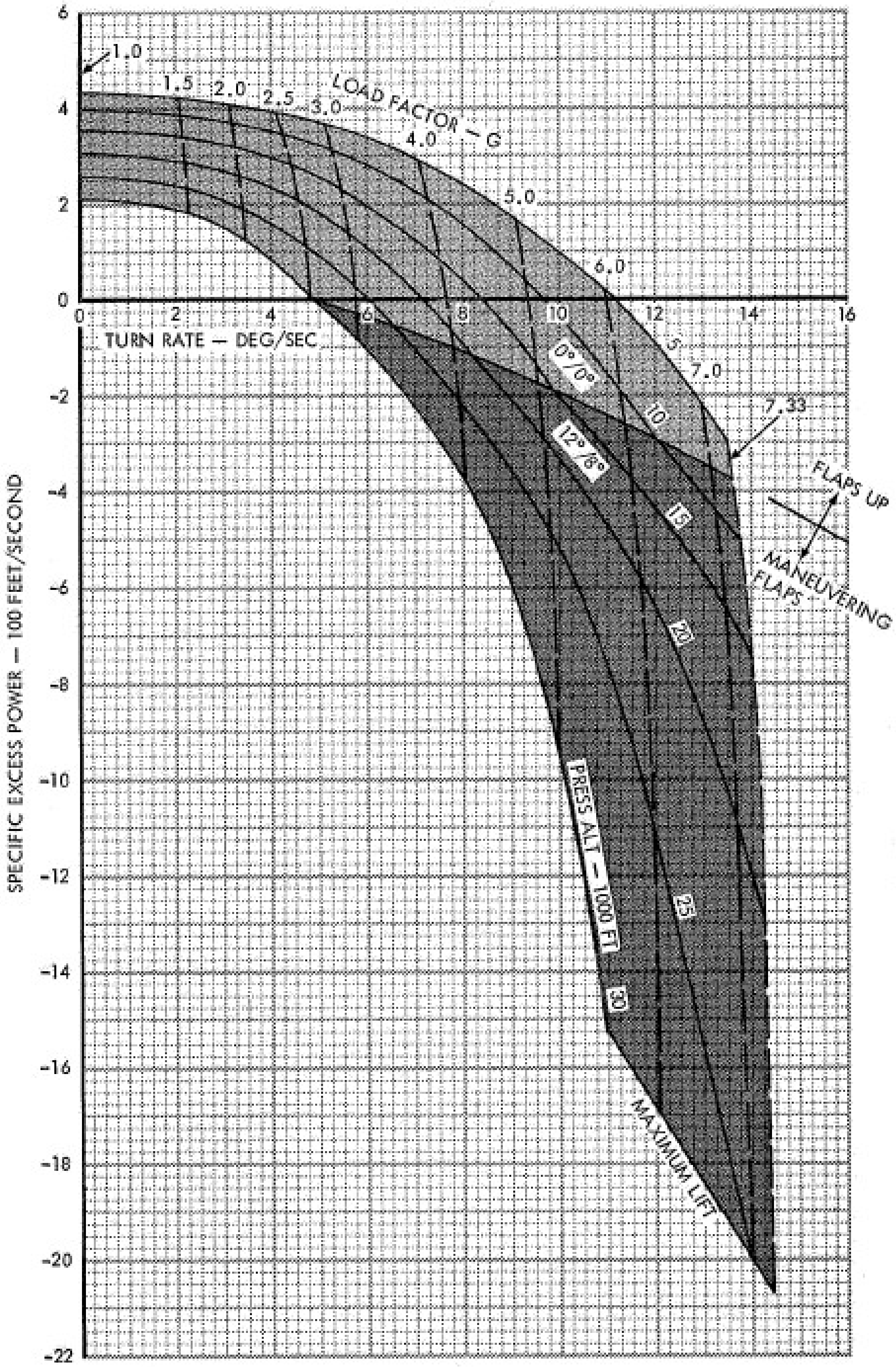
MODEL: F-5F
DATE: 1 AUGUST 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

TURN PERFORMANCE

SPECIFIC EXCESS POWER AND TURN RATE
MAXIMUM THRUST
STANDARD DAY
(2) AIM-9 MISSILES
GROSS WEIGHT 14,150 POUNDS

0.9 IMN



F-5 1-606(2)B

FA8-17 (Sheet 2).

DART TARGET TOW

PART 9

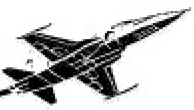


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TABLE OF CONTENTS

Page numbers underlined denote charts.

DART TARGET PERFORMANCE DATA (GENERAL)

The tabular charts in this part provide performance data for aircraft equipped with the Dart tow target (A/A37U-15 Tow Target System). Additional Dart target information included with the normal procedures in section II of T.O. 1F-5E-34-1-1 is required for complete performance coverage. The tabular charts in this part provide for the determination of single-engine takeoff speed and two-engine climb, level acceleration, and cruise. Use of a drag number is not required; the drag number is incorporated into the chart data. Takeoff data in part 2 is used initially to compute aft stick speed, takeoff speed, and ground roll distance. To obtain corrected takeoff data for the Dart target configuration, add 15 knots to aft stick speeds and 25 knots to takeoff speeds and increase the takeoff ground roll distance by 40 percent. High rates of rotation or extreme nose high attitudes during takeoff may result in the target striking the ground.

MINIMUM SAFE SINGLE-ENGINE TAKEOFF SPEED CHART

The Minimum Safe Single-Engine Takeoff Speed chart (FA9-1, sheets 1 and 2,) provides the minimum takeoff speed required for a safe single-engine maximum thrust takeoff (with or without inboard pylon fuel tank) in the event of engine failure with the Dart target stowed. The chart parameters are runway temperature and runway pressure altitude. Using maximum power on the operating engine, the listed speed will provide a rate of climb of 100 feet per minute with gear down, maneuver flaps at FULL position, and the target stowed. Accelerate to 10 knots above safe single-engine takeoff speed before the landing gear is retracted. If an engine fails after gear retraction, maximum power single-engine thrust is sufficient to sustain flight for all conditions shown in the chart. The best airspeed in this situation is 200 to 210 KIAS (Ⓕ 210 to 220 KIAS). In all of the situations, the flaps should be in the fully down position to increase lift and minimize drag.

MILITARY THRUST CLIMB CHARTS

Military Thrust Climb charts (FA9-2, sheets 1 and 2) provide fuel, range and time required to climb to a specified altitude with the target stowed, in tow, or after the target has been dropped. The target stowed and target in tow charts are based on a climb at 305 KIAS with flaps up and a start climb gross weight of 16,000 pounds. The target dropped chart is based on a climb at 340 KIAS (Ⓕ 345 KIAS) with flaps up and a start climb gross weight of 14,000 pounds. Each chart contains a correction factor (change per 1000 pounds %) to be used when the aircraft gross weight varies from the data basis.

TARGET LAUNCH AND REEL OUT

A minimum of 3000 feet AGL must be attained before target launch. Optimum launch speed is 200 KIAS. The optimum reel out speed is 200 to 220 KIAS in straight and level flight with maneuvering flaps until cable is fully reeled out (approximately 2 minutes).

LEVEL FLIGHT ACCELERATION CHART

The Level Flight Acceleration chart (FA9-3) with target in tow (with or without external fuel tank) provides the fuel, range, and time required for military thrust acceleration from 200 to 300 KIAS with flaps up. A variable percentage change factor at specific altitudes and for gross weights above or below the data basis gross weight is used to compute the fuel, range, and time for acceleration.

LEVEL FLIGHT CRUISE CHARTS

Level Flight Cruise charts provide cruise airspeed and maximum range data at specific altitudes without inboard pylon fuel tank (FA9-4, sheets 1 and 2) or with 150-gal inboard pylon fuel tank (FA9-5, sheets 1 and 2) for the aircraft with target in tow and after target drop. Airspeed is presented in both mach and KIAS, with flaps up. Range is determined as a function of nautical miles per pound. Time is determined as a function of minutes per pound for the specified altitudes. A percentage of change factor is applied to nautical miles per pound or minutes per pound, as applicable, to allow for other than the data basis gross weight used in each chart. The chart for target in tow provides for both maximum range and maximum time. The charts for target stowed and target dropped provide for maximum range only.

ENGINE FAILURE WITH TARGET IN TOW

If engine failure occurs with the target in tow, the recommended minimum airspeeds, service ceiling, and gross weights are as follows:

Min Airspeed (KIAS)	Service Ceilings (Temp Std +20 C) With Tank (FT)	Service Ceilings (Temp Std +20 C) No Tank (FT)
Ⓔ 270 Ⓕ 275	11,000 10,000	14,000 12,000
	Gross Weight (lb)	
	With Tank	No Tank
Ⓔ 270 Ⓕ 275	17,300 17,700	15,500 16,000

WARNING

Single-engine MIL thrust will not sustain flight at any altitude.

NOTE

Empty pylon fuel tank may be jettisoned to reduce drag.

TARGET DROP

Maintain 1500 feet above terrain to cut cable and drop target. Use cruise flaps and adjust speed according to target condition as follows:

Target Damage	Airspeed (Approximate KIAS)
Undamaged	Up to 300
Moderate to Heavy	200
Severe	Drop on range. Do not attempt to return target to base.

E

MODEL: F-5E
DATE: 1 AUGUST 1977
DATA BASIS: **FLIGHT TEST**
ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

DART TARGET
MINIMUM SAFE SINGLE-ENGINE TAKEOFF SPEED

MAXIMUM THRUST
GEAR DOWN
FULL FLAPS

NO EXTERNAL FUEL TANK

GROSS WT – 16,534 LB
CG – 16% MAC

RUNWAY TEMP – °C \ PRESS ALT – FT	TAKEOFF SPEED – KIAS SL	2000	4000	6000
+15 (AND COLDER)	178	178	178	178
+17	178	178	178	188
+24	178	178	178	—
+25	178	178	180	—
+26	178	178	189	—
+33	178	178	—	—
+35	178	184	—	—
+36	178	189	—	—
+42	178	—	—	—
+44	189	—	—	—
+45	—	—	—	—

INBD 150-GAL FUEL TANK

GROSS WT – 18,250 LB
CG – 16% MAC

RUNWAY TEMP – °C \ PRESS ALT – FT	TAKEOFF SPEED – KIAS SL	2000	4000	6000
0 (AND COLDER)	186	186	186	186
+2	186	186	186	195
+3	186	186	186	—
+12	186	186	186	—
+13	186	186	195	—
+14	186	186	—	—
+22	186	186	—	—
+23	186	195	—	—
+24	186	—	—	—
+31	186	—	—	—
+32	195	—	—	—

Note

WHERE BLANKS (-) OCCUR IN THE TABLE, SINGLE-ENGINE TAKEOFF IS IMPOSSIBLE.

F-5 1-570(1)E

FA9-1 (Sheet 1).

MODEL: F-5F
DATE: 1 AUGUST 1977
DATA BASIS: **FLIGHT TEST**
ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

F

DART TARGET
MINIMUM SAFE SINGLE-ENGINE TAKEOFF SPEED

MAXIMUM THRUST

GEAR DOWN
FULL FLAPS

NO EXTERNAL FUEL TANK

GROSS WT – 17,050 LB
CG – 13% MAC

RUNWAY TEMP – °C / PRESS ALT – FT	TAKEOFF SPEED – KIAS SL	2000	4000	6000
+9 (AND COLDER)	184	184	184	184
+10	184	184	184	187
+11	184	184	184	—
+18	184	184	184	—
+19	184	184	188	—
+20	184	184	—	—
+28	184	184	—	—
+29	184	188	—	—
+30	184	—	—	—
+37	184	—	—	—
+38	188	—	—	—

INBD 150-GAL FUEL TANK

GROSS WT – 18,750 LB
CG – 14% MAC

RUNWAY TEMP – °C / PRESS ALT – FT	TAKEOFF SPEED – KIAS SL	2000	4000	6000
-6 (AND COLDER)	192	192	192	192
-5	192	192	192	200
-4	192	192	192	—
+5	192	192	192	—
+6	192	192	200	—
+7	192	192	—	—
+16	192	192	—	—
+17	192	200	—	—
+18	192	—	—	—
+25	192	—	—	—
+26	200	—	—	—

Note

WHERE BLANKS (-) OCCUR IN THE TABLE, SINGLE-ENGINE TAKEOFF IS IMPOSSIBLE.

F-5 1-570(2)D

FA9-1 (Sheet 2).

E

MODEL: F-5E
DATE: 1 AUGUST 1977
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

DART TARGET MILITARY THRUST CLIMB

FUEL, RANGE, AND TIME

W/WO EXTERNAL FUEL TANK

TARGET STOWED

FLAPS UP
305 KIAS

START CLIMB GROSS WEIGHT 16,000 LB

SEA LEVEL TO: (FT)	FUEL (LB)	RANGE (NM)	TIME (MIN)	*CHANGE PER 1000 LB (%)
5000	117	5	0.9	9
10,000	241	11	2.1	10
15,000	374	20	3.4	11
20,000	522	31	5.1	12
25,000	696	47	7.4	13
30,000	911	71	10.6	17

*FUEL, RANGE, AND TIME:
INCREASE ABOVE / DECREASE BELOW } 16,000 LB

CAUTION

REDUCE AIRSPEED IF VIBRATION OCCURS.

TARGET IN TOW

FLAPS UP
305 KIAS

AVERAGE CLIMB GROSS WEIGHT — 16,000 LB

3000 FT TO: (FT)	FUEL (LB)	RANGE (NM)	TIME (MIN)	*CHANGE PER 1000 LB (%)
5000	55	3	0.5	12
10,000	202	10	1.8	12
15,000	368	21	3.5	14
20,000	567	36	5.8	15
25,000	832	60	9.3	19

*FUEL, RANGE, AND TIME
INCREASE ABOVE / DECREASE BELOW } 16,000 LB

TARGET DROPPED

FLAPS UP
340 KIAS

AVERAGE CLIMB GROSS WEIGHT — 14,000 LB

SEA LEVEL TO: (FT)	FUEL (LB)	RANGE (NM)	TIME (MIN)	*CHANGE PER 1000 LB (%)
5000	84	4	0.7	8
10,000	169	9	1.4	8
15,000	257	14	2.3	10
20,000	347	22	3.3	10
25,000	440	31	4.4	11
30,000	534	41	5.8	11

*FUEL, RANGE, AND TIME:
INCREASE ABOVE / DECREASE BELOW } 14,000 LB

F-5 1-571(20)

FA9-2 (Sheet 1).

MODEL: F-5F
DATE: 1 AUGUST 1977
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

DART TARGET MILITARY THRUST CLIMB

FUEL, RANGE, AND TIME
W/WO EXTERNAL FUEL TANK

F

TARGET STOWED

FLAPS UP
305 KIAS

START CLIMB GROSS WEIGHT — 16,000 LB

SEA LEVEL TO: (FT)	FUEL (LB)	RANGE (NM)	TIME (MIN)	*CHANGE PER 1000 LB (%)
5000	117	5	0.9	9
10,000	242	11	2.1	10
15,000	381	20	3.5	11
20,000	537	32	5.3	13
25,000	719	48	7.7	16
30,000	950	75	11.2	18

*FUEL, RANGE, AND TIME:
INCREASE ABOVE / DECREASE BELOW } 16,000 LB

CAUTION

REDUCE AIRSPEED IF VIBRATION OCCURS.

TARGET IN TOW

FLAPS UP
305 KIAS

AVERAGE CLIMB GROSS WEIGHT — 16,000 LB

3000 FT TO: (FT)	FUEL (LB)	RANGE (NM)	TIME (MIN)	*CHANGE PER 1000 LB (%)
5000	55	3	0.5	11
10,000	203	10	1.8	12
15,000	375	21	3.6	13
20,000	585	37	6.0	15
25,000	868	63	9.7	21

*FUEL, RANGE, AND TIME:
INCREASE ABOVE / DECREASE BELOW } 16,000 LB

TARGET DROPPED

FLAPS UP
345 KIAS

AVERAGE CLIMB GROSS WEIGHT — 14,000 LB

SEA LEVEL TO: (FT)	FUEL (LB)	RANGE (NM)	TIME (MIN)	*CHANGE PER 1000 LB (%)
5000	83	4	0.6	8
10,000	170	9	1.4	9
15,000	259	15	2.3	9
20,000	352	22	3.3	9
25,000	447	32	4.5	10
30,000	544	43	5.9	10

*FUEL, RANGE, AND TIME:
INCREASE ABOVE / DECREASE BELOW } 14,000 LB

F-5 1-571(2)D

FA9-2 (Sheet 2).

MODEL: F-5E
DATE: 1 MARCH 1978
DATA BASIS: **FLIGHT TEST**
ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

DART TARGET
LEVEL FLIGHT ACCELERATION

E

MILITARY THRUST
GEAR UP
FLAPS UP

TARGET IN TOW

NO EXTERNAL FUEL TANK

ACCELERATION FROM 200 TO 300 KIAS				
GROSS WEIGHT - 15,000 LB				
ALTITUDE (FT)	FUEL (LB)	RANGE (NM)	TIME (MIN)	*CHANGE PER 1000 LB (%)
3000	59	2	0.5	15
5000	64	3	0.7	16
10,000	80	4	0.8	20
15,000	109	7	1.3	28

*FUEL, RANGE, AND TIME:
INCREASE ABOVE / DECREASE BELOW } 15,000 LB

INBD 150-GAL FUEL TANK

ACCELERATION FROM 200 TO 300 KIAS				
GROSS WEIGHT - 16,000 LB				
ALTITUDE (FT)	FUEL (LB)	RANGE (NM)	TIME (MIN)	*CHANGE PER 1000 LB (%)
3000	64	2	0.5	15
5000	70	3	0.6	16
10,000	90	4	0.9	21
15,000	127	7	1.5	36

*FUEL, RANGE, AND TIME:
INCREASE ABOVE / DECREASE BELOW } 16,000 LB

F-5 1-572(20)

FA9-3 (Sheet 1).

MODEL: F-5F
DATE: 1 APRIL 1978
DATA BASIS: **FLIGHT TEST**
ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

DART TARGET LEVEL FLIGHT ACCELERATION

F

MILITARY THRUST
GEAR UP
FLAPS UP

TARGET IN TOW

NO EXTERNAL FUEL TANK

ACCELERATION FROM 200 TO 300 KIAS				
GROSS WEIGHT - 16,000 LB				
ALTITUDE (FT)	FUEL (LB)	RANGE (NM)	TIME (MIN)	*CHANGE PER 1000 LB (%)
3000	69	2	0.6	17
5000	75	3	0.7	18
10,000	100	5	1.0	25
15,000	150	9	1.7	48

*FUEL, RANGE, AND TIME:
INCREASE ABOVE / DECREASE BELOW } 16,000 LB

INBD 150-GAL FUEL TANK

ACCELERATION FROM 200 TO 300 KIAS				
GROSS WEIGHT - 17,000 LB				
ALTITUDE (FT)	FUEL (LB)	RANGE (NM)	TIME (MIN)	*CHANGE PER 1000 LB (%)
3000	74	3	0.6	16
5000	82	3	0.7	17
10,000	110	5	1.1	24
15,000	170	10	2.0	47

*FUEL, RANGE, AND TIME:
INCREASE ABOVE / DECREASE BELOW } 17,000 LB

F-5 1-572(2)C

FA9-3 (Sheet 2).

E

MODEL: F-5E
DATE: 1 MARCH 1978
DATA BASIS: **FLIGHT TEST**
ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

DART TARGET LEVEL FLIGHT CRUISE

MAXIMUM RANGE, TIME, AND AIRSPEED
FLAPS UP

NO EXTERNAL FUEL TANK

TARGET IN TOW

GROSS WEIGHT — 14,000 LB

ALTITUDE (FT)	MAXIMUM RANGE			*CHANGE PER 1000 LB (%)
	MACH	KIAS	NM/LB	
10,000	0.48	265	0.097	5
15,000	0.54	275	0.104	5
20,000	0.62	285	0.114	4
25,000	0.69	290	0.125	4
ALTITUDE (FT)	**MAXIMUM TIME**			***CHANGE PER 1000 LB (%)**
	MACH	KIAS	MIN/LB	
10,000	0.45	250	0.0194	6
15,000	0.50	250	0.0192	7
20,000	0.55	250	0.0191	7
25,000	0.62	255	0.0190	6

*NM/LB AND MIN/LB:
INCREASE BELOW / DECREASE ABOVE 14,000 LB

TARGET STOWED

GROSS WEIGHT — 14,000 LB

ALTITUDE (FT)	MAXIMUM RANGE			*CHANGE PER 1000 LB (%)
	MACH	KIAS	NM/LB	
10,000	0.51	285	0.112	5
15,000	0.56	285	0.119	4
20,000	0.63	290	0.130	4
25,000	0.70	295	0.142	4
30,000	0.80	305	0.159	4

*NM/LB:
INCREASE BELOW / DECREASE ABOVE 14,000 LB

TARGET DROPPED

GROSS WEIGHT — 13,000 LB

ALTITUDE (FT)	MAXIMUM RANGE			*CHANGE PER 1000 LB (%)
	MACH	KIAS	NM/LB	
10,000	0.54	300	0.139	4
15,000	0.58	295	0.152	4
20,000	0.66	305	0.168	4
25,000	0.70	295	0.186	5
30,000	0.79	300	0.202	5

*NM/LB:
INCREASE BELOW / DECREASE ABOVE 13,000 LB

F-5 1-573(20)

FA9-4 (Sheet 1).

MODEL: F-5F
DATE: 1 AUGUST 1977
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

F

DART TARGET LEVEL FLIGHT CRUISE

MAXIMUM RANGE, TIME, AND AIRSPEED
FLAPS UP
NO EXTERNAL FUEL TANK

TARGET IN TOW

GROSS WEIGHT – 15,000 LB

ALTITUDE (FT)	MAXIMUM RANGE			*CHANGE PER 1000 LB (%)
	MACH	KIAS	NM/LB	
10,000	0.51	282	0.092	5
15,000	0.59	300	0.099	4
20,000	0.65	300	0.108	4
25,000	0.73	305	0.120	3
ALTITUDE (FT)	**MAXIMUM TIME**			***CHANGE PER 1000 LB (%)**
	MACH	KIAS	MIN/LB	
10,000	0.46	255	0.0176	7
15,000	0.51	255	0.0175	7
20,000	0.57	260	0.0173	7
25,000	0.63	260	0.0174	7

*NM/LB AND MIN/LB:
INCREASE BELOW / DECREASE ABOVE 15,000 LB

TARGET STOWED

GROSS WEIGHT – 15,000 LB

ALTITUDE (FT)	MAXIMUM RANGE			*CHANGE PER 1000 LB (%)
	MACH	KIAS	NM/LB	
10,000	0.52	290	0.105	5
15,000	0.59	300	0.112	4
20,000	0.65	300	0.122	4
25,000	0.72	300	0.134	4
30,000	0.79	300	0.146	4

*NM/LB:
INCREASE BELOW / DECREASE ABOVE 15,000 LB

TARGET DROPPED

GROSS WEIGHT – 14,000 LB

ALTITUDE (FT)	MAXIMUM RANGE			*CHANGE PER 1000 LB (%)
	MACH	KIAS	NM/LB	
10,000	0.57	315	0.132	3
15,000	0.63	320	0.143	4
20,000	0.69	320	0.159	4
25,000	0.74	310	0.172	4
30,000	0.80	305	0.188	5

*NM/LB:
INCREASE BELOW / DECREASE ABOVE 14,000 LB

F-5 1-573(2)C

FA9-4 (Sheet 2).

MODEL: F-5E
DATE: 1 MARCH 1978
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

E

DART TARGET LEVEL FLIGHT CRUISE

MAXIMUM RANGE, TIME, AND DISTANCE
FLAPS UP
INBD 150-GAL FUEL TANK

TARGET IN TOW

GROSS WEIGHT — 15,000 LB				
ALTITUDE (FT)	MAXIMUM RANGE			* CHANGE PER 1000 LB (%)
	MACH	KIAS	NM/LB	
10,000	0.51	285	0.094	4
15,000	0.55	280	0.101	4
20,000	0.63	290	0.110	4
25,000	0.71	295	0.120	4
ALTITUDE (FT)	MAXIMUM TIME			* CHANGE PER 1000 LB (%)
	MACH	KIAS	MIN/LB	
10,000	0.47	260	0.0186	7
15,000	0.52	260	0.0186	8
20,000	0.57	260	0.0184	8
25,000	0.63	260	0.0183	8

* NM/LB AND MIN/LB:
INCREASE BELOW / DECREASE ABOVE } 15,000 LB

TARGET STOWED

GROSS WEIGHT — 15,000 LB				
ALTITUDE (FT)	MAXIMUM RANGE			* CHANGE PER 1000 LB (%)
	MACH	KIAS	NM/LB	
10,000	0.52	290	0.105	4
15,000	0.57	290	0.114	4
20,000	0.64	295	0.124	4
25,000	0.71	295	0.134	3
30,000	0.79	300	0.150	3

* NM/LB:
INCREASE BELOW / DECREASE ABOVE } 15,000 LB

TARGET DROPPED

GROSS WEIGHT — 14,000 LB				
ALTITUDE (FT)	MAXIMUM RANGE			* CHANGE PER 1000 LB (%)
	MACH	KIAS	NM/LB	
10,000	0.54	300	0.132	2
15,000	0.58	295	0.145	3
20,000	0.63	290	0.159	4
25,000	0.68	285	0.173	4
30,000	0.78	295	0.193	4

* NM/LB:
INCREASE BELOW / DECREASE ABOVE } 14,000 LB

F-5 1-681(20)

FA9-5 (Sheet 1).

MODEL: F-5F
DATE: 1 APRIL 1978
DATA BASIS: **FLIGHT TEST**
ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

F

DART TARGET LEVEL FLIGHT CRUISE

MAXIMUM RANGE, TIME, AND AIRSPEED
FLAPS UP
INBD 150-GAL FUEL TANK

TARGET IN TOW

GROSS WEIGHT — 16,000 LB

ALTITUDE (FT)	MAXIMUM RANGE			*CHANGE PER 1000 LB (%)
	MACH	KIAS	NM/LB	
10,000	0.53	295	0.090	4
15,000	0.59	300	0.097	4
20,000	0.66	305	0.105	4
25,000	0.73	305	0.115	3
ALTITUDE (FT)	**MAXIMUM TIME**			***CHANGE PER 1000 LB (%)**
	MACH	**KIAS**	**MIN/LB**	
10,000	0.49	270	0.0169	7
15,000	0.54	275	0.0168	7
20,000	0.60	275	0.0166	7
25,000	0.60	275	0.0167	7

*NM/LB AND MIN/LB:
INCREASE BELOW / DECREASE ABOVE } 16,000 LB

TARGET STOWED

GROSS WEIGHT — 16,000 LB

ALTITUDE (FT)	MAXIMUM RANGE			*CHANGE PER 1000 LB (%)
	MACH	KIAS	NM/LB	
10,000	0.53	295	0.099	4
15,000	0.59	300	0.107	4
20,000	0.66	305	0.117	4
25,000	0.73	305	0.127	3
30,000	0.82	310	0.142	3

*NM/LB:
INCREASE BELOW / DECREASE ABOVE } 16,000 LB

TARGET DROPPED

GROSS WEIGHT — 15,000 LB

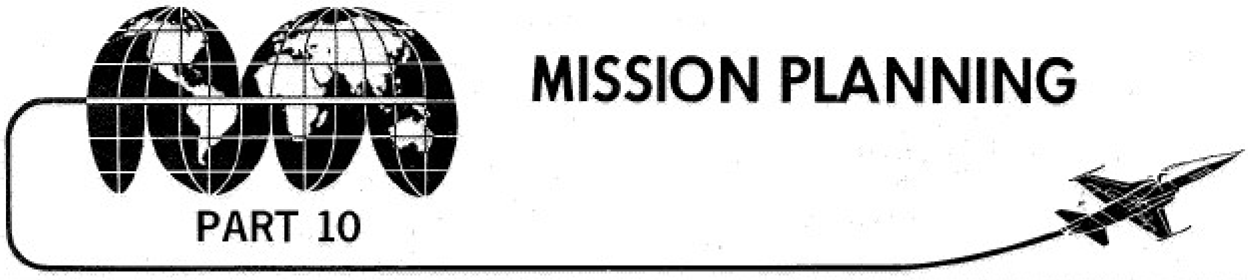
ALTITUDE (FT)	MAXIMUM RANGE			*CHANGE PER 1000 LB (%)
	MACH	KIAS	NM/LB	
10,000	0.56	310	0.129	3
15,000	0.60	305	0.139	4
20,000	0.69	320	0.152	4
25,000	0.77	325	0.166	3
30,000	0.86	330	0.186	4

*NM/LB:
INCREASE BELOW / DECREASE ABOVE } 15,000 LB

F-5 1-681(2)A

FA9-5 (Sheet 2).

MISSION PLANNING



F-5E 1-85

TABLE OF CONTENTS

Page numbers underlined denote charts.

PURPOSE OF MISSION PLANNING

The purpose of mission planning is to obtain optimum performance for any specific mission. Optimum performance will vary, for example, from maximum time on station to maximum radius with no time on station. Exact requirements will vary, depending upon the type of mission to be flown. The use of parts 1 thru 8 is illustrated in this part by means of sample problems.

MISSION PLANNING SAMPLE PROBLEM

NOTE

The following problem is an exercise in the use of the performance charts. It is not intended to reflect actual or proposed tactical missions.

SAMPLE PROBLEM

The problem is to determine the maximum target radius available for an F-5E configured with wingtip missiles, four MK-82 bombs on the wing pylons, a 275-gallon external fuel tank on the centerline pylon, and 560 rounds of 20mm ammunition. For simplicity, no descents are included in the problem. Takeoff is made with maximum thrust followed by a military thrust climb on course to optimum cruise altitude. Cruise is at constant altitude at long range speed.

NOTE

The centerline store must be retained until inboard MK-82 bombs are released (see section V, Inflight Carriage and Sequencing Limitations).

At the target area, a 5-minute sea level combat fuel allowance is calculated with military thrust at 0.8 mach number. After bombs, missiles, centerline store, and ammunition are expended, a military thrust climb to optimum cruise altitude and a constant altitude long-range cruise speed cruise to the base are calculated, allowing a 600-pound fuel reserve at altitude over the base for descent and landing. Zero wind and standard day conditions are assumed throughout the mission except for takeoff and landing.

Supplemental Data

a. The loaded gross weight with (2) AIM-9J missiles, 560 rounds of 20mm ammunition, (4) MK-82 bombs, (1) 275-gallon centerline fuel tank, (5) pylons, and full internal fuel is 20,582 pounds. Tabulating the weight data from FA1-2 results in the following:

	WT - LB
F-5E with Launcher Rails	15,050
(2) AIM-9J Missiles	340
(4) MK-82 (LDGP) Bombs	2124
(1) 275-gal CL Tank (full fuel)	2004
(5) Pylons (170 + 244 + 256)	670
560 Rounds of 20mm Ammunition (with links)	394
Total Gross Weight	20,582

b. Usable fuel load is 6175 pounds. Aircraft weight with zero fuel and without four MK-82 bombs, 314 pounds of ammunition, the 275-gallon pylon tank, and the two AIM-9J missiles is 11,400 lb.

General Comments

a. This type of mission cannot be solved directly as none of the conditions at the maximum radius point, such as fuel used, gross weight, or radius, is known. The problem must be worked from the beginning and the end of the mission, starting with the takeoff weight and empty weight (zero fuel) and working toward the weight at the start of combat. When the radius from takeoff to combat equals the radius from combat back to the base, the problem is solved.

b. As the outbound weight and drag are greater than the weight and drag during the return to base, more fuel is required to reach the combat zone than to return. Therefore, as a starting point, assume that 51 percent of the total fuel has been used when combat begins. This will determine the aircraft weight at this point and both the outbound and return radii can be computed. By comparing the two radii, the combat weight can be adjusted and the computations revised until the mission is balanced. The fuel used during combat and during the climb to cruise altitude after combat is hardly affected by small adjustments in the combat weight; therefore, the problem of adjusting the two radii to match is quickly resolved.

c. As the maximum radius of this aircraft is considerably in excess of the distance shown in FA4-1, this mission is not in the short range category for planning purposes.

Takeoff and Accelerate

The mission is now worked from takeoff to the combat zone. Drag Index at takeoff from FA1-1:

Basic Aircraft Configuration	2
(2) AIM-9J Missiles	16
(1) CL 275 gal Tank	32
(2) MK-82 Bombs (inboard) (2) MK-82 Bombs (outboard)	70
Drag Index	120

Takeoff factor is 12 (FA2-4) for standard day at Sea Level. Takeoff time, fuel and distance (FA3-1) required before reaching MIL thrust climb:

Taxi Fuel Flow	18 lb/min
Estimated Taxi Time	5 min
Taxi Fuel Allowance (5 X 18)	90 lb
Static Mil Thrust Runup Time	1 min
Engine Runup Fuel Allowance	119 lb

Total Takeoff Allowance

Gross Weight at Brake Release	20,582 − (90 + 119) = 20,373 lb
Time to Accelerate to Mil Climb Speed	1.1 min
Fuel	315 lb
Distance	3 nm
Start Climb Weight	20,373 − 315 = 20,058 lb

Climb to Optimum Cruise Altitude

Referring to FA3-4 sheets 1 and 2:

Start Climb Weight	20,058 lb
Drag Index	120
Fuel to Climb	1170 lb
Time to Climb	15 min
Distance to Climb	105 nm
Weight at End of Climb	18,888 lb
Altitude at End of Climb (FA4-2)	30,000 ft

Determination of Gross Weight at Start of Combat

Total usable fuel for the mission is 6175 lb. Total fuel used before start of combat: 6175 x 0.51 = 3149 lb. Therefore, with 51% of the fuel used the gross weight at start of combat is: 20,582 − 3149 = 17,433 lb.

Cruise to Start of Combat

Cruise Altitude	30,000 ft
Weight at Start of Cruise	18,888 lb
Weight at End of Cruise (estimated for start of combat)	17,433 lb
Fuel for Cruise (18,888 – 17,433)	1455
Average Cruise Weight	18,161 lb
Drag Index	120
Specific Range (FA4-6, sheet 2)	0.150 nm/lb fuel
Cruise Range (0.15 x 1455)	218 nm
Cruise mach number (Limited by configuration)	0.85 mach
Cruise Time (FA4-6, sheet 1)	26 min

Change in Gross Weight During Combat

For the purpose of obtaining the fuel used during 5 minutes of combat at 0.8 mach at military thrust at sea level, use FA8-1.

Combat Altitude	Sea Level
Combat Speed	0.80 IMN
Combat Fuel Flow	158 lb/min
Fuel Used in 5 Min	158 x 5 = 790 lb
Bomb Weight	2124 lb
Ammunition Weight	314 lb
(2) AIM-9J Missiles	340 lb
Empty centerline tank	229 lb
Weight Loss During Combat	790 + 2124 + 314 + 340 + 229 = 3797
Estimated Weight at End of Combat	17,433 – 3797 = 13,636 lb

Total Outbound Distance at Start of Combat

	Distance nm	Time min
Takeoff and Acceleration	3	7.1
Climb to Cruise Altitude	105	15
Cruise at 30,000 ft to Start of Combat	218	26
Total Outbound Distance and Time to Combat	326	48.1

Climb to Optimum Altitude and Cruise to Base

The mission must now be worked from empty weight (zero fuel) back toward end of combat.
The drag index after combat and for the remainder of the mission is:

Basic Aircraft Configuration	2
(2) Launcher Rails	1
(2) Outboard Pylons (2) Inboard Pylons	53
(1) Centerline Pylon	14
Drag Index	70

Weight with zero fuel and without four MK-82 bombs, 314 pounds of 20mm ammunition, external fuel tank, and two AIM-9J missiles is 11,400 pounds.

Weight over base at end of cruise: 11,400 + 600 = 12,000 lb.

The return climb and cruise to base can now be calculated.

Start climb weight at end of combat: 13,636 pounds.

Using FA3-4, sheets 1 and 2, climb to 39,000 feet.

Drag Index	70
Fuel to Climb	725 lb
Time	9.8 min
Distance	72 nm
Start Cruise Weight (13,636 – 725)	12,911 lb
Cruise Altitude (FA4-1)	39,000 ft
End Cruise Weight	12,000 lb
Average Cruise Weight	12,456 lb
Specific Range (FA4-6, sheet 2)	0.240 nm/lb of fuel
Cruise Fuel	911 lb
Cruise Range 911 x 0.240)	219 nm
Cruise Time	26.2 min
Total Range to Base (219 + 72)	291 nm

Balancing the Mission

Using the estimated combat weight of 17,433 lb, the ranges out and back are:

Range Out	326 nm
Range Back	291 nm
Difference	35 nm

In order to balance the mission, combat weight must be increased to decrease the range out and increase the range back. An average value of the fuel used during cruise is (0.15 + 0.240) ÷ 2 = 0.2 nm/lb, or 5.0 lb per nm. The combat weight must be increased only sufficiently to account for half of the 35 nm difference.

Fuel for 18 nm 18 x 5.0 = 90 lb

The cruise to combat weight range leg must be shortened and the inboard leg must be lengthened for the effect of 90 lb fuel change.

Therefore:

Outbound

Change of Range	.15 x 90 = 13 nm
Cruise Range	218 – 13 = 205 nm
Total Range	326 – 13 = 313 nm

Inbound

Change of Range	0.240 x 90 = 22 nm
Cruise Range	219 + 22 = 241 nm
Total Range	291 + 22 = 313 nm

The mission is now balanced and the mission radius is 313 nm. A final adjustment of the time to cruise would result in the following values:

Outbound Range	205 nm
Cruise Time	24.6 min
Inbound Range	241 nm
Cruise Time	28.6 min

A summary of the balanced mission is shown in FA10-1.

Alternate Method of Balancing Mission

An alternate method of balancing a mission of this type, where it is required to determine the maximum range of the aircraft, is to solve a very simple equation, which states that the total range outbound is equal to the total range inbound. Referring to the Sample Mission Planning Chart in FA10-1, most of the fuel and range values for the various phases of the mission are readily calculated by knowing the ground rules or the particular conditions of the flight plan pertaining to these phases. For instance, the range during cruise while using fuel from a certain pylon tank will be determined by the quantity of fuel available in that tank. When the chart shown in FA10-1 is filled in with all the parts of the mission that can be determined from the ground rules, there will be one outbound cruise phase just prior to combat and one inbound cruise phase (in this case, the entire inbound cruise leg) whose distances are unknown. These two cruise legs must now be determined so that the total distance outbound is equal to the total distance inbound. The fuel available for these two cruise legs is that amount of the total mission fuel remaining after all the other mission phases are determined, and is found as follows:

Known Amount of Fuel Used:

Start, Taxi, Takeoff	524
Climb	1170
Combat	790
Climb-Cruise to Base	725
Reserve	600
	3809 lb

Total Mission Usable Fuel = 6175 lb

Fuel Available for the Two Unknown Cruise Legs (6175 – 3809) = 2366 lb

Although 2366 lb of fuel is available for the two cruise legs, it is not yet known how this fuel is divided between the two legs as to balance the mission. For this reason, the average cruise weight used to determine the specific range for each of the two cruise legs will have to be estimated for the first try and may have to be slightly adjusted in a second calculation if a more accurate value of specific range is required. Assume that 60% of available fuel is used outbound. (1420 lb.)

Data for the two unknown cruise legs are as follows:

Average Cruise Weight Outbound:
18,888 − (1420 ÷ 2) = 18,178

Cruise Specific Range Outbound (FA4-6, sheet 2)
= 0.150 nm/lb.

Average Cruise Weight Inbound:
12,000 + (946 ÷ 2) = 12,473

Cruise Specific Range Inbound (FA4-6, sheet 2)
=0.240 nm/lb.

Total Known Distance Outbound:

Taxi, takeoff	3
Climb	105
	108 nm

Total Known Distance Inbound = 72 nm.

To set up the equation used to balance the mission:

Let X = pounds of fuel available for the outbound cruise leg.

2366 − X = pounds of fuel available for the inbound cruise leg.

0.150 X = outbound cruise leg in nm.

0.240 (2366 − X) = inbound cruise leg in nm.

SAMPLE MISSION PLANNING LOG HI-LO-HI INTERDICTION

PHASE OF MISSION	POWER SETTING	* FUEL USED — LB	TIME	DISTANCE
5-MIN TAXI 1-MIN RUNUP TAKEOFF & ACCELERATE	IDLE MIL MAX — MIL	524	7.1	3
CLIMB TO 30,000 FT	MIL	1170	15	105
CRUISE AT 30,000 FT	0.85 IMN	1365	24.6	205
COMBAT AT SEA LEVEL 0.80 IMN	MIL	790	5	0
RELEASE BOMBS & TANK FIRE AMMO & MISSILES	———	[3007]	0	0
CLIMB FROM SEA LEVEL TO 39,000 FT	MIL	725	9.8	72
CRUISE AT LONG RANGE SPEED AT 39,000 FT	0.88 IMN	1001	28.6	241
LANDING FUEL RESERVES	———	600	0	0

POSITION	TOTAL GROSS WEIGHT — LB	TOTAL TIME	TOTAL DISTANCE	AIRSPEED	ALTITUDE — FT
	20,582	0	0	———	SL
START				———	
END	20,058	7.1	3	325 KIAS	SL
START				325 KIAS	
END	18,888	22.1	108	325 KIAS	30,000
START				501 KTAS	
END	17,523	46.7	313	501 KTAS	30,000
START				529 KIAS	SL
END	16,733	51.7	313	529 KIAS	SL
START				———	
END	13,726	51.7	313	———	SL
START				335 KIAS	
END	13001	61.5	241	335 KIAS	39,000
START				505 KTAS	
END	12,000	90.1	0	505 KTAS	39,000
START				———	
END	11,400	90.1	0	———	SL
				———	

* USABLE FUEL WEIGHT

INTERNAL	4400 LB
CL PYLON TANK	1775 LB
TOTAL	6175 LB

[ ] STORE WEIGHT ONLY

DATA BASIS
- STANDARD DAY
- ZERO WIND CONDITIONS
- PYLON FUEL TANK DROPPED WHEN EMPTY

F-5 1-621(1)C

FA10-1.

The equation to balance the mission is now written and solved as follows:

Total Distance Outbound = Total Distance Inbound.

Outbound Cruise Leg + 108 nm = Inbound Cruise Leg + 72 nm

0.15X + 108	= 0.240(2366 – X) + 72
0.15X + 108	= (568 – 0.240X) + 72
0.15X + 0.240X	= (568 + 72) – 108
0.390X	= 532
X	= 1364 lb of fuel for outbound cruise leg
2366 – X	= 1002 lb of fuel for inbound cruise leg
0.15 x 1364	= 205 nm outbound cruise leg
0.24 x 1002	= 241 nm inbound cruise leg

To check the results of equation:

205 + 108	= 241 + 72
313 nm	= 313 nm

GRAPHIC SOLUTION OF MISSION

Figure FA10-2 graphically illustrates the sample mission illustrated in FA10-1 and can be used to study the effects of various modifications on the radius of any similar mission. The solid lines are a plot of fuel remaining versus mission radius in the sample mission. If the slopes of the return climb and cruise lines are maintained, these lines may be shifted with changes in combat fuel or landing fuel and the resulting mission radius determined with reasonable accuracy. The dashed lines show the effects of changes in the mission.

TAKEOFF AND LANDING DATA CARD

The following example illustrates the preparation of the takeoff and landing data card. Takeoff and landing data are obtained from parts 2 and 7, respectively and the fuel allowance for taxi is obtained from the fuel flow rates tabulated on FA3-1. The takeoff weight is the gross weight with full fuel less the fuel allowance for taxi and engine runup at military power. The landing weight immediately after takeoff with two engines operating and with stores, and for single-engine after stores are jettisoned is the takeoff weight less an average fuel allowance of 300 lb for takeoff and go-around.

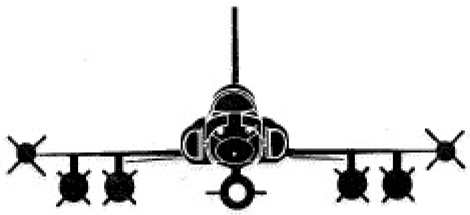
For the purpose of the sample problem, the conditions and calculations are as follows.

Gross Weight (Full Fuel)	20,582 lb and cg 13% MAC
Gross Weight (Pylon Stores Jettisoned)	16,454 lb and cg 14% MAC
Runway Pressure Altitude	Sea Level
Runway Temperature	10°C
Wind	10 kt from 60°
Runway Length	11,000 ft
Runway Slope	1% uphill
RCR (Wet Runway)	12
Drag Chute Option	No chute
Flap Position	FULL

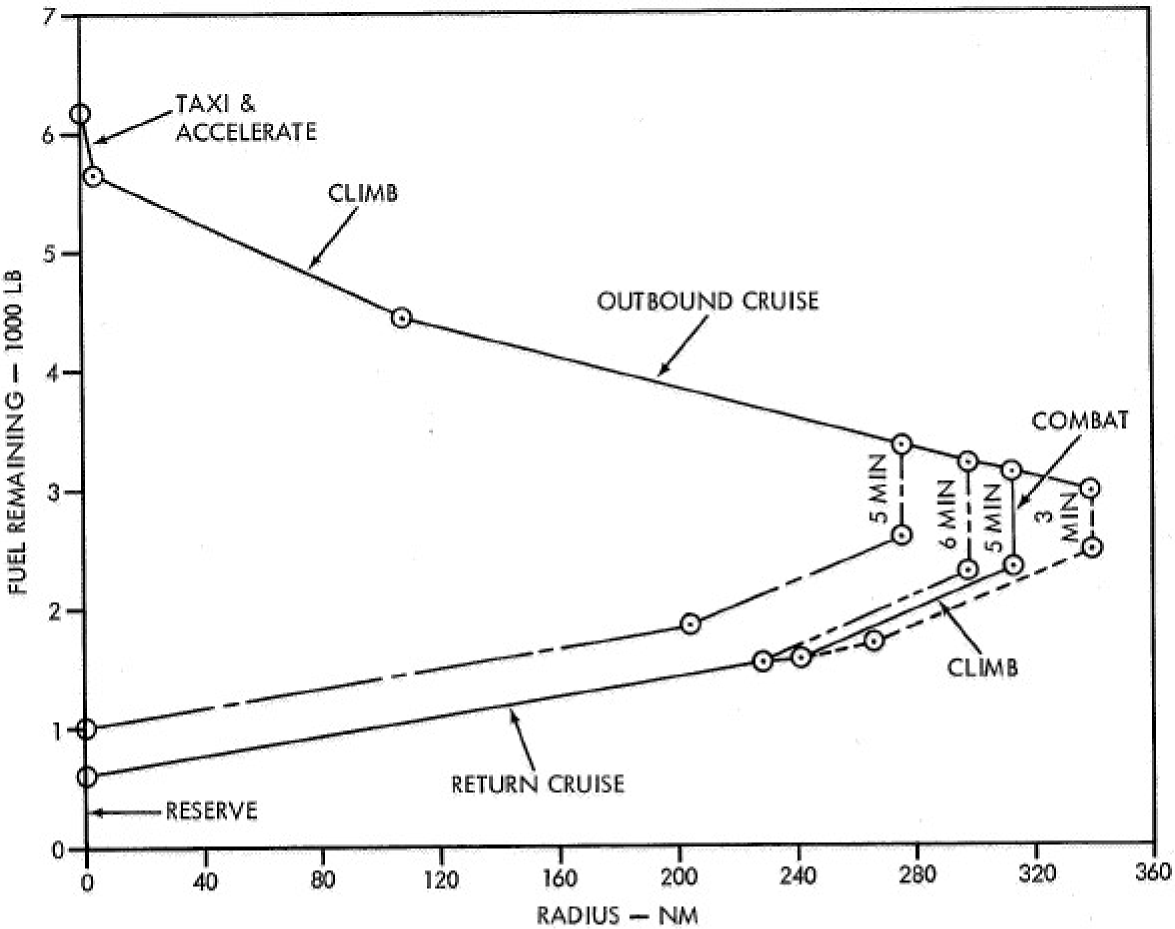
The takeoff calculations are as follows:

Taxi Fuel Allowance	18 lb/min x 5= 90 lb fuel
Engine Runup at MIL	119 lb/min x 1= 119 lb fuel
Takeoff Gross Weight (With Stores)	20,582 – (90 + 119) =20,373 lb
Headwind Component (FA1-9)	5 kt
Takeoff Speed (FA2-2)	177 KIAS
Aft Stick Speed (FA2-2)	167 KIAS
Takeoff Factor (FA2-4)	12.4

HI-LO-HI INTERDICTION PROFILE



(4) MK-82 LD
(2) AIM-9J MISSILES
(1) CL 275-GAL TANK



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FA10-2.

Takeoff Ground Run (5 kt Headwind, 1% uphill) (FA2-5):	3200 + 160= 3360 ft
Takeoff Gross Weight (Pylon Stores Jettisoned)	16,454 – (90+119) =16,245 lb
Minimum Safe Single-Engine Takeoff Speed:	
(Stores Jettisoned) (FA2-7)	154 KIAS
(With Stores) (FA2-7)	206 KIAS
Critical Field Length (with stores), No Drag Chute, 5 kt Headwind,	
RCR = 23, 1% uphill (FA2-10):	7800 + 390=8190 ft
RCR = 12, 1% uphill (FA2-10):	8700 + 435=9135 ft
Critical Engine Failure Speed, No Drag Chute, 5 kt Headwind, RCR 12, (FA2-12):	141 + 5 = 146 KIAS
Refusal Speed, No Drag Chute, 5 kt Headwind, RCR = 12, (FA2-12):	160 + 5 = 165 KIAS
Normal Acceleration Speed at 2000 ft (FA2-15)	140 KIAS

Acceleration Tolerance: $\frac{11,000 - 8190}{1000} \times 3 = 8$ KIAS

Check speed at 2000 ft marker: 140 – 8 =132 KIAS

The landing conditions are as follows:

	After Takeoff and Go-Around	After Jettisoning Pylon Stores	Final Landing
Ldg Gr Wt	20,073 lb	15,945 lb	12,000 lb
C.G. (% MAC)	13	14	18
Press Alt	SL	SL	SL
Temperature	+10	+10	+10
Headwind	5 kt	5 kt	20 kt
Rwy Length	11,000 ft	11,000 ft	11,000 ft
RCR	12	12	12
Drag Chute	No Chute/ Chute	No Chute/ Chute	No Chute/ Chute
Flaps	FULL	FULL	FULL

The landing calculations are as follows:

Approach Spd (FA7-1, sheet 1)	193 KIAS	171 KIAS	146 KIAS
Touchdown FA7-1, sheet 1)	180 KIAS	160 KIAS	137 KIAS

Landing Ground Roll, No Drag Chute:

FA7-2	5100 ft	4200 ft	2600 ft
RCR of 12/12/12 FA7-4	8100 ft	6600 ft	4100 ft

Landing Ground Roll With Drag Chute:

FA7-3	3900 ft	3000 ft	1900 ft
RCR of 12/12/12 FA7-5	5100 ft	3900 ft	2450 ft

Minimum Distance from Touchdown to 125 KT Hook Engagement:

No Drag Chute RCR of 12/12/12 FA7-7	3700 ft	2200 ft	650 ft

TAKEOFF AND LANDING DATA CARD

CONDITIONS

	TAKEOFF	LANDING
GROSS WEIGHT & CG	20,373 LB 13%	12,000 LB 18%
RUNWAY LENGTH	11,000 FT	11,000 FT
RUNWAY PRESSURE ALTITUDE	SL	SL
RUNWAY SLOPE	UPHILL 1%	______ %
RUNWAY TEMPERATURE	+10°C	+10°C
RUNWAY WIND COMPONENT	HEADWIND 5 KT	HEADWIND 20 KT
DRAG CHUTE OPTION	NO CHUTE	CHUTE OR NO CHUTE
RCR	12	12

TAKEOFF

ACCELERATION CHECK SPEED & MARKER	132 KIAS	2000 FT
CRITICAL ENGINE FAILURE SPEED	146 KIAS	
AFT STICK SPEED	167 KIAS	
TAKEOFF SPEED & GROUND RUN DISTANCE	177 KIAS	3360 FT
MINIMUM SAFE SINGLE-ENGINE SPEED:		
WITH STORES	206 KIAS	
NO STORES (OR JETTISONED)	154 KIAS	

LANDING

	AFTER TAKEOFF & GO-AROUND		FINAL LANDING
	TWO ENGINES (W/STORES)	SINGLE ENGINE (W/O STORES)	
GROSS WEIGHT & CG	20,073 LB 13%	15,945 LB 14%	12,000 LB 18%
FINAL APPROACH SPEED	193 KIAS	171 KIAS	146 KIAS
TOUCHDOWN SPEED	180 KIAS	160 KIAS	137 KIAS
MAX HOOK ENGAGEMENT SPEED	120 KT	120 KT	120 KT
LANDING GROUND ROLL:			
WITH DRAG CHUTE	5100 FT	3900 FT	2450 FT
NO DRAG CHUTE	8100 FT	6600 FT	4100 FT
DISTANCE FROM TOUCHDOWN TO HOOK ENGAGEMENT	3700 FT	2200 FT	650 FT

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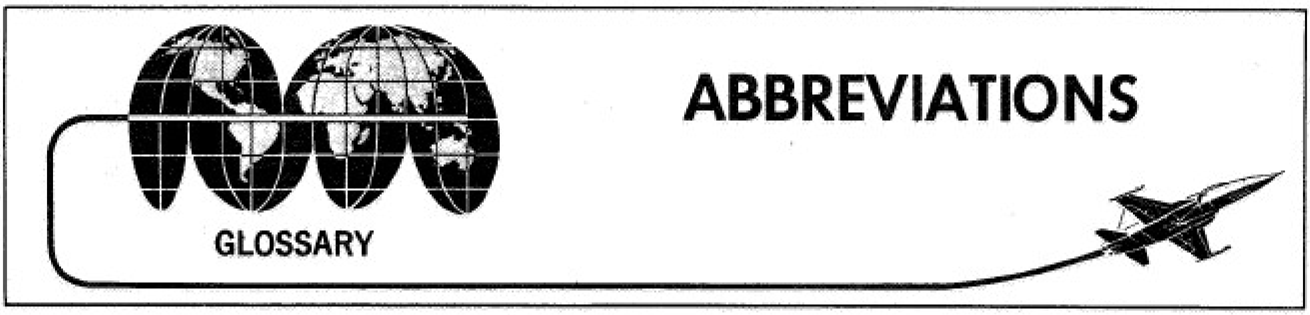
FA10-3.



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Abbreviation	*Word*
	A
AB	Afterburner
AC ac	Alternating Current
ACCL	Acceleration
ACQ	Acquisition
ADF	Automatic Direction Finder
ADI	Attitude Director Indicator
ADL	Armament Datum Line
AEC	Automatic Exposure Control
AGE	Aerospace Ground Equipment
AGL	Above Ground Level
AHRS	Attitude and Heading Reference System
ALN	Align
ALT	Altitude
AMI	Airspeed Mach Indicator
AMMO	Ammunition
AOA	Angle of Attack
ARB	Arresting Barrier
ARG	Arresting Gear
ARL	Armament Reference Line
ARR HK	Arresting Hook
ATT	Attitude
AUG	Augmenter
AUX	Auxiliary
	B
BARR	Barrier
BIT	Built-in-Test
BITE	Built-in-Test Equipment
BRG	Bearing
BRSIT	Boresight
BRT	Bright
	C
CADC	Central Air Data Computer
CAMR	Camera
CAS	Calibrated Airspeed
CCW	Counterclockwise

Abbreviation	*Word*
CDI	Course Deviation Indicator
CEP	Circular Error Probable
CG cg	Center of Gravity
CHAN	Channel
CI	Control—Indicator
CLR	Clear
C/L, CL	Centerline
CLNC	Clearance
COMM	Communications
CONT	Control
CONT'D	Continued
CR	Cruise
CRS	Course
CW	Clockwise
	D
DA/MTK	Drift Angle/Magnetic Track
dB	Decibel
DC dc	Direct Current
DIST	Distance
DEG/ SECOND	Degrees per second
DEST	Destination
DEV	Deviation
DF	Direction Finding
DTK	Desired Track
	E
E	East
EGT	Exhaust Gas Temperature
ELEC	Electric (also electrical, electronic)
EMER	Emergency
ENG	Engine
ERR	Error
ETA	Estimated Time of Arrival
ETR	Enter
EX-G	Excess G (acceleration of gravity)
EXT	External

Abbreviation	*Word*
	F
FCR	Fire Control Radar
FLAPS, FLPS	Flaps
FLT	Flight
FORM	Formation
FPM fpm	Feet per minute
FPS fps	Feet per second
FSII	Fuel System Icing-Inhibitor
FWD	Forward
	G
G	Gravity (load factor)
GAL	Gallon
GB	Gyro Bias
GC	Gyro Compass
GCA	Ground Controlled Approach
GCU	Generator Control Unit
GS/GTK	Groundspeed/Ground Track
GS	Groundspeed (knots). Speed relative to ground.
GW,GR WT	Gross Weight
	H
HDG	Heading
HSI	Horizontal Situation Indicator
HTR	Heater
HYD	Hydraulic
Hz	Hertz
	I
IAS	Indicated Air Speed
IFF	Identification Friend/Foe
IFR	Instrument Flight Rules
IGV	Inlet Guide Vanes
IMN	Indicated Mach Number
IN in	Inch(es)
INBD	Inboard
IND	Indicator
IN RNG	In Range
INTERCOM	Intercommunication(s)
INTVL-SEC	Interval-Seconds
ITO	Instrument Takeoff
	J
JASU	Jet Assist Starting Unit
	K
KCAS	Knots Calibrated Airspeed

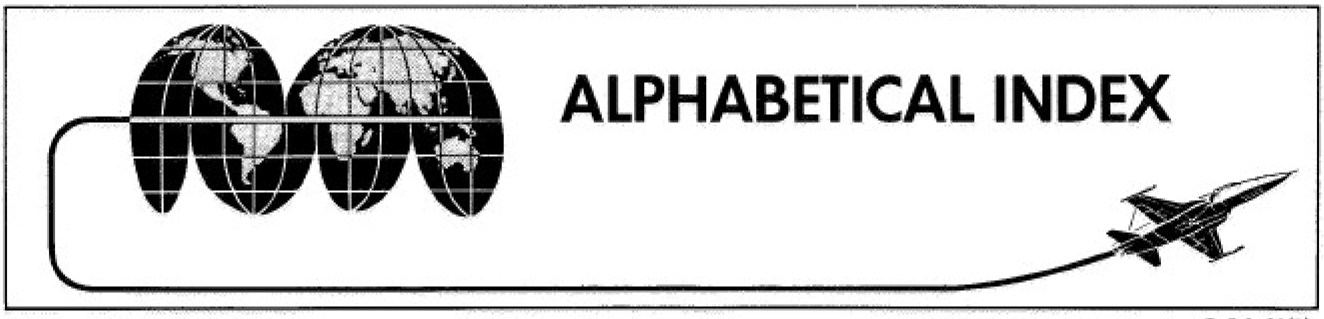
Abbreviation	*Word*
KEAS	Knots Equivalent Airspeed
kHz	Kilohertz
KIAS	Knots Indicated Airspeed
KT	Knot(s)
KTAS	Knots True Airspeed
	L
L	Left
LAT	Latitude
LAU,LCHR	Launcher
LB lb	Pound
LB/HR	Pounds per hour
LB/HR/ENG	Pounds per hour per engine
LB/MIN	Pounds per minute
LCOSS	Lead Computing Optical Sight System
LDG	Landing
LE	Leading Edge
LG,LDG GR	Landing Gear
LK ON	Lock-On
LONG	Longitude
LTD	Limited
	M
M	Maneuver (FLAP THUMB switch Position Only)
MAC	Mean Aerodynamic Chord
Mach	Speed Relative to Speed of Sound
MAG	Magnetic
MAL	Malfunction
MAN	Maneuvering
MAX	Maximum Power
MHz	Megahertz
MIC	Microphone
MIL	Military Power
MIN	Minimum/Minute
Mmax	Maximum Mach number
MIN/LB min/lb	Minutes per pound
MK	Mark
MON	Monitor
MSL	Mean Sea Level; Placard Position of Sight Mode Selector
MTK	Magnetic Track
	N
N	North
NAV	Navigation
NM nm	Nautical Mile(s)
NM/LB nm/lb	Nautical miles per pound
NO.	Number

Abbreviation	*Word*
NORM	Normal
NPI	Nozzle Position Indication
O	
OBS	Obstacle
ODU	Optical Display Unit
OUTBD	Outboard
OPR	Operate
OXY	Oxygen
P	
PP	Present Position
PPH	Pounds per hour
PRI	Primary
PRESS	Pressure
Ps	Specific excess power
PSR	Photo Scale Reciprocal
PWR	Power
Q	
QTY	Quantity
R	
R	Right
RAD	Radiation
RADAR	Radio Detection and Ranging
R/C	Rate of Climb (also see Vertical Velocity)
RCR	Runway Condition Reading
RD	Round (of ammunition)
REC	Receive
RECON	Reconnaissance
REF	Reference
REL	Relative
R/D	Rate of Descent (also see Vertical Velocity)
RKT	Rocket
RMT	Remote
RNG	Range
RNG/BRG	Range/Bearing (INS)
RTD	Resistance-Temperature-Detector
RWY	Runway
S	
S	South
SAS	Stability Augmenter System
SEC	Secondary
SIF	Selective Identification Feature
SL	Sea level
SPD	Speed
SPD BK	Speed Brake
STAB	Stability
STBY	Standby
STD	Standard
STOR	Stored
STR	Steer
SW	Switch
SYS	System(s)
T	
TAC	Tactical
TAC	Tactical Air Command
TACAN	Tactical Air Navigation
TAS	True Airspeed
TCTO	Time Compliance Technical Order
TE	Trailing Edge
TEMP	Temperature
TGT	Target
TGTK	True Ground Track
TMN	True Mach Number
TTD	Time to Destination
U	
UHF	Ultrahigh Frequency
UPDT	Update
UNLTD	Unlimited
V	
VAC vac	Volts Alternating Current
VAR	Variation
VDC vdc	Volts Direct Current
VEL	Velocity
VERT	Vertical
VOL	Volume
VV	Vertical Velocity
W	
W	West
W/	With
W/O	Without
WPN	Weapon
WT	Weight
X	
XFMR-RECT	Transformer-Rectifier
XMTR	Transmitter

Abbreviation	*Word*
	Y
Yaw	Yaw

SCIENTIFIC & MATHEMATICAL SYMBOLS

ΔTEMP	Temperature correction
α(Alpha)	Speed of sound in ambient air
α_O	Speed of sound at sea level
P(Rho)	Ambient air pressure
P_O	Air pressure at sea level
δ(Delta)	Relative air pressure
ρ(Rho)	Ambient air density
ρ_O	Air density at sea level
σ(Sigma)	Relative air density



ALPHABETICAL INDEX

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